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A STATISTICAL STUDY OF SURFACE AND UPPER-AIR CONDITIONS IN CYCLONES AND ANTICYCLONES PASSING OVER DAVENPORT, IOWA.[1]

By ANTON D. UDDEN.

[University of Pennsylvania, Philadelphia, Pa., October 23, 1922.]

SUBJECT AND PURPOSE OF INVESTIGATION.

This paper presents the results of a statistical study of surface and upper-air conditions in cyclones and anticyclones passing over Davenport, Iowa. A knowledge of such conditions is essential in the forecasting of weather. It is also a matter of importance to aerial navigation. The surface-air conditions can readily be studied by means of the daily weather maps and the station data of the United States Weather Bureau. It is more difficult, however, to obtain information on the upper air. This is usually accomplished by sending up kites and balloons equipped with specially designed apparatus for recording the upper-air conditions, and by following the progress of a pilot balloon with a theodolite. The cloud records made at the United States Weather Bureau stations also constitute a valuable source of information. The upper-air studies described in this paper, are based upon such cloud data. In preparing this paper the writer has wished to direct attention to a statistical method which appears useful in the study of local weather conditions in the distribution of the weather elements of HIGHS and LOWS and also to call to notice the great wealth of material for investigation which has accumulated in the stations of the United States Weather Bureau.

METHOD OF STUDY.

The statistical method which has been employed in this investigation is similar to the one previously used by Clayton in his cloud studies. The mechanical details of the method, however, were taken from a paper by J. A. Udden. A diagram is constructed, as shown in Figure 1, for the purpose of dividing a cyclone or anticyclone into a number of definitely circumscribed areas. Four concentric circles are drawn, whose radii represent distances of 100, 400, 700, and 1,000 miles, respectively. Eight radii 45° apart and extending from the inner to the outer circle, delimit 24 subareas symmetrically oriented about the central one. These are numbered consecutively from 1 to 25, as shown in the figure.

The diagram just described is here used to subdivide a cyclone or anticyclone into small areas in order to study the average weather conditions prevailing in each area when it overlies Davenport, Iowa. It is drawn to the scale of the United States daily weather maps upon a sheet of transparent paper. Having selected a weather map in which Davenport is situated within a HIGH or LOW, the next step is to determine the region of the cyclone or anticyclone in which the city lies. The center of the diagram on the transparent paper is then superposed upon the center of the LOW or HIGH in such a manner that the north-south diameter of the diagram coincides with the meridian. The number of the subarea in which Davenport lies can then be read off directly. Thus, in Figure 2, which illustrates the procedure, Davenport falls within subarea 15 of the cyclonic diagram. In this case the city lies within that part of a LOW whose center overlies the eastern part of the Province of Ontario, Canada.

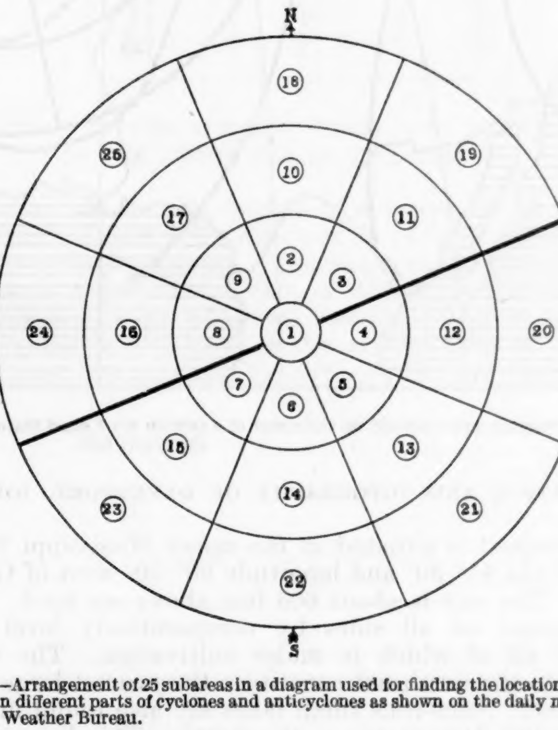

FIG. 1.—Arrangement of 25 subareas in a diagram used for finding the location of Davenport in different parts of cyclones and anticyclones as shown on the daily maps of the U. S. Weather Bureau.

It is now a simple matter to note the weather conditions prevailing in subarea 15 of the cyclonic diagram. Upon examining a large number of weather maps, Davenport is found frequently to appear in this area. By obtaining a sufficient number of observations, it is possible to calculate the average weather conditions, such as the amount of cloudiness, wind velocity, frequency of precipitation, etc., characteristic of any particular subarea of a LOW when that subarea overlies Davenport. Similarly, we may obtain the average weather conditions which Davenport experiences in each one of the 25 subareas of cyclones (or anticyclones) represented on the diagram.

SOURCE AND CHARACTER OF DATA.

The present investigation is based upon an examination of the morning and evening weather maps for a period of 22 years, from 1892 to 1913, inclusive. Approximately 13,000 maps were examined. The files of

[1] This manuscript has been received since the untimely death of the author on Sept. 5, 1922, at San Antonio, Tex. Cf. MO. WEATHER REV., October, 1922, 50: 540.

the Davenport Weather Bureau station supplied the morning maps, and the evening maps were studied at the Chicago Weather Bureau office. All of the observational data were obtained from the Davenport station.

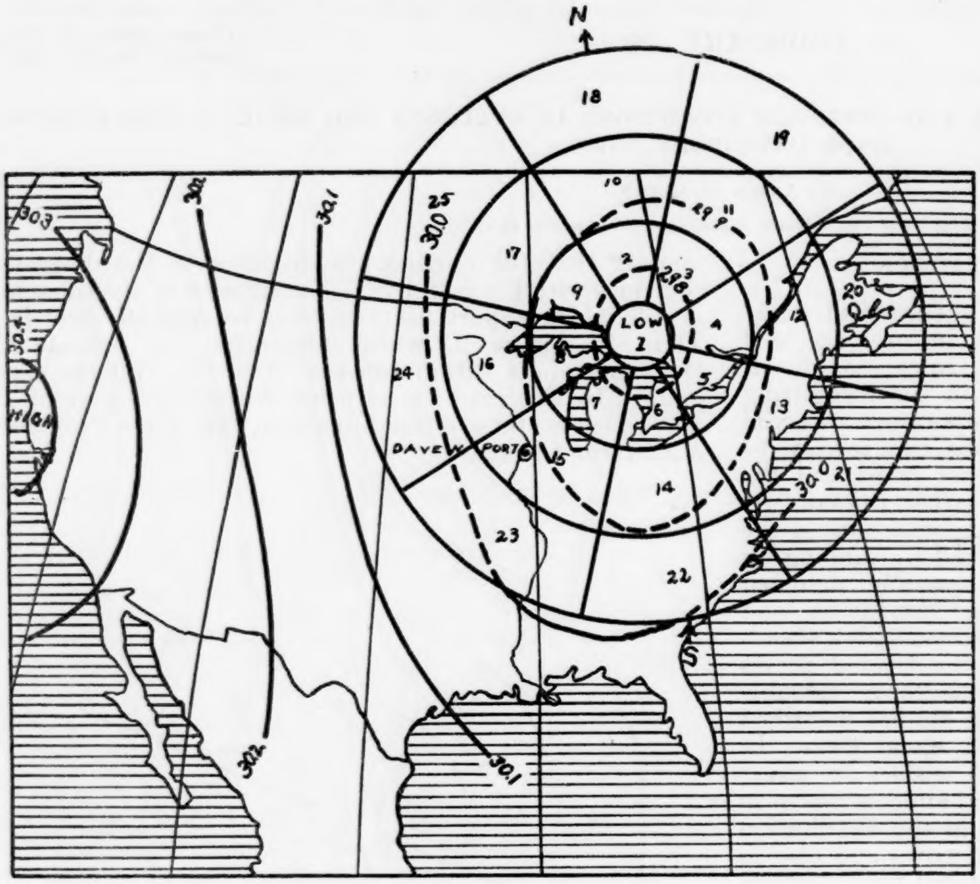

FIG. 2.—Diagram superimposed on the center of a LOW on the United States weather map, to locate the area in which Davenport falls.

LOCATION AND TOPOGRAPHY OF DAVENPORT, IOWA.

Davenport is situated in the upper Mississippi Valley at latitude 41° 30′ and longitude 90° 30′ west of Greenwich. The city is about 606 feet above sea level. It is surrounded on all sides by comparatively level land almost all of which is under cultivation. The Great Lakes to the northeast constitute the nearest large body of water. Numerous small lakes are also found in Wisconsin and Minnesota on the north. This large water surface probably exerts a noticeable effect upon the weather conditions at Davenport.

Davenport lies on the west bank of the Mississippi River, whose valley extends several miles eastward of the city. In the opposite direction the valley broadens out and turns to the southwest. The Weather Bureau station is situated about 1,500 feet from the bank of the river and approximately 75 feet below the level of the upland. Roughly speaking, the station lies about halfway up the slope from the river's edge.

SURFACE AND UPPER AIR CONDITIONS IN THE SUBAREAS OF CYCLONES OVERLYING DAVENPORT, IOWA.

Number of observations.—The number of times that Davenport was within each subarea of the cyclonic diagram is shown in Figure 3. The numbers include both morning and evening observations for the entire period under consideration. Thus the city was visited by the central area of cyclones 119 times, while in subarea 15 there were 521 observations. The distribution of the number of observations among the various subareas of the cyclonic diagram is shown graphically by the shaded areas. The more darkly stippled regions represent increasingly larger numbers of observations. The limiting values of each degree of shading may be ascertained from the numbers within the small rectangles along the boundary lines of the shaded areas. In Figures 3 and 4, there are six degrees of shading whose limiting values are given in the following table:

	Number of observations.
1. Unshaded	0–100
2. Light stipple	101–200
3. Medium stipple	201–300
4. Dark stipple	301–400
5. Very dark stipple	401–500
6. Solid black	501–600

A like interpretation applies to all similar diagrams in this paper.

The number of times that Davenport was visited by each cyclonic area is of importance in determining the reliability of the average values of the weather elements for the various subareas. Davenport appeared most frequently in subarea 15 of the cyclonic diagram, in all 521 times. The smallest number of observations, namely 17, is found in subarea 18. With such extremes, it is evident that the averages in some subareas will be more reliable than in others. It is believed, however, that the average values of the weather elements will be fairly reliable except in 18 and 25. The total number of observations in the cyclones is 4,318.

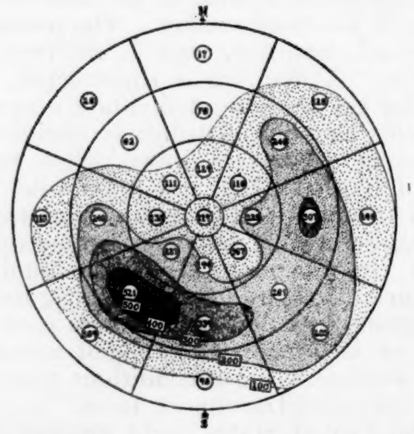

FIG. 3.—Number of observations in the different subareas of cyclones at Davenport.

Frequency of observations in different subareas.—The total number of observations in any one of the subareas of a cyclone depends upon two factors. First, the number is proportional to the frequency with which cyclones travel along those paths which include Davenport within the given subarea. Secondly, the number of

observations is proportional to the areas of the several subdivisions of the Figure 1. By expressing the number of observations in each part in terms of the same unit of

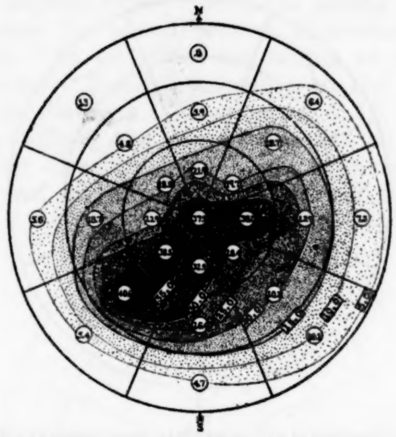

FIG. 4.—Frequency of observations in percentages for the separate subareas of cyclones at Davenport.

area, we obtain the frequency with which Davenport falls within any particular part of a cyclone. The

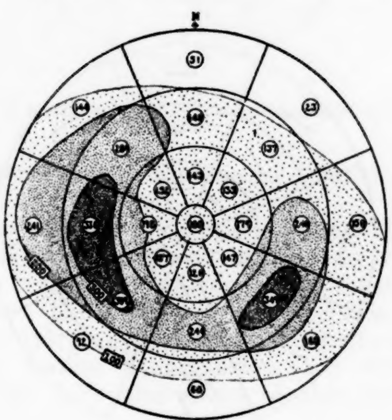

FIG. 5.—Number of observations in the different subareas of anticyclones at Davenport.

frequency values given in Figure 4 represent the number of observations per 10,000 square miles of area.

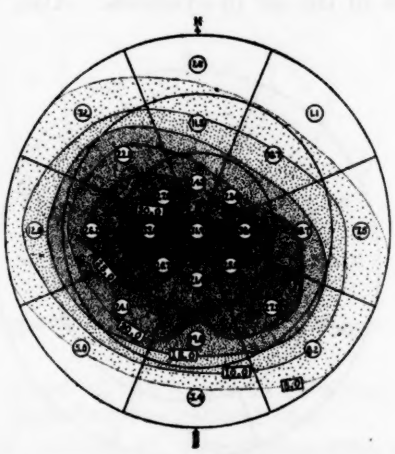

FIG. 6.—Frequency of observations in percentages for the separate subareas of anticyclones at Davenport.

It is interesting to note that the frequency areas in cyclones (see fig. 4) are elongated from WSW. to ENE. This agrees approximately with the direction of the storm tracks across Davenport as shown by Van Cleef. Furthermore, the frequency values below the WSW.–ENE. diameter [3] are considerably greater than those found in the corresponding upper subareas. This is clearly shown in the table given below, in which the last column expresses in per cent the ratio of the frequencies in the lower (southern) to those in the corresponding upper (northern) subareas. From this we may conclude that the cyclone centers travel more frequently to the north of Davenport than to the south.

TABLE 1.—*Frequencies of observations in upper (northern) and lower (southern) subareas (see fig. 4).*

Lower.	Subarea number.	Upper.	Subarea number.	Ratio, lower to upper.
				Per cent.
7.3	20	6.4	19	114
23.9	12	18.7	11	128
38.2	4	19.7	3	194
10.2	21	.8	18	1,275
20.3	13	5.9	10	344
28.4	5	21.9	2	130
4.7	22	1.3	25	362
26.4	14	4.8	17	550
32.9	6	18.8	9	170
5.4	23	5.6	24	96
40.6	15	18.7	16	217
38.5	7	22.9	8	168

DIRECTION OF THE SURFACE WINDS AND THE CURRENTS IN THE UPPER AIR IN CYCLONES.

Surface winds.—Davenport experiences a characteristic resultant surface wind direction in each of the 25 areas of the cyclonic diagram. Similarly, each type of clouds possesses a resultant direction in every subarea. This resultant may be obtained vectorially. For example, Davenport was visited by the central area of cyclones 119 times, during which the surface wind blew as follows:

Direction from which wind blew.	Number of times.
N	7
NE	9
E	17
SE	15
S	21
SW	29
W	14
NW	7
Total	119

The vector diagram of these wind directions is plotted in Figure 7.

Beginning at "A" each of the directions is represented, consecutively, with a line whose length and direction indicate the number of times that the wind blew from the given direction. The resultant directon is given by the heavy line AB, which closes the polygon.

The resultant wind and cloud directions within each of the subareas of the cyclonic diagram have been studied at five arbitrary levels, namely:

Levels.	Altitude in feet (approximate average.)
Surface wind	
Nimbus and stratus clouds	2,300
Cumulus, strato-cumulus and cumulo-nimbus clouds	6,000
Alto-stratus and alto-cumulus clouds	13,000
Cirrus cirro-stratus and cirro-cumulus clouds	23,000

The direction of the wind at the higher altitudes was obtained from the observed motion of the clouds within the respective subareas. In each of the diagrams,

[3] The heavy line in figure 1 divides the subareas into upper and lower group.—ED.

Figures 8, 9, 12, 13, and 16, the resultant directions are represented by arrows flying with the wind. The

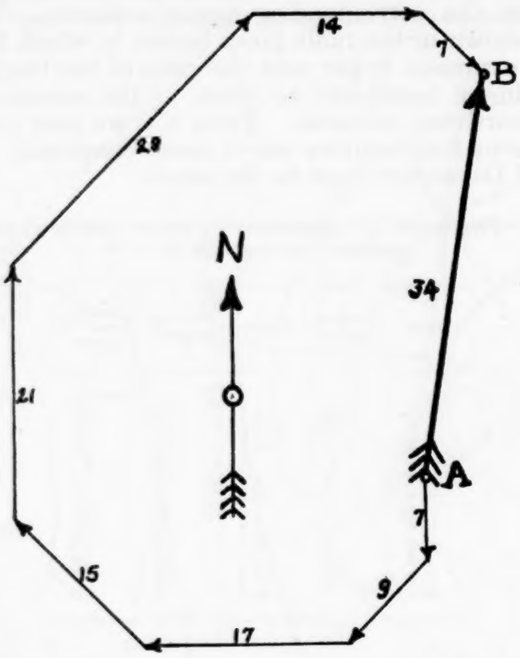

FIG. 7.—Vector diagram showing resultant surface wind direction in the central subarea of cyclones at Davenport.

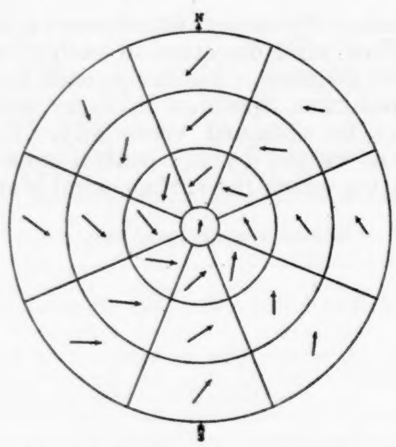

FIG. 8.—Direction of surface winds in cyclones at Davenport.

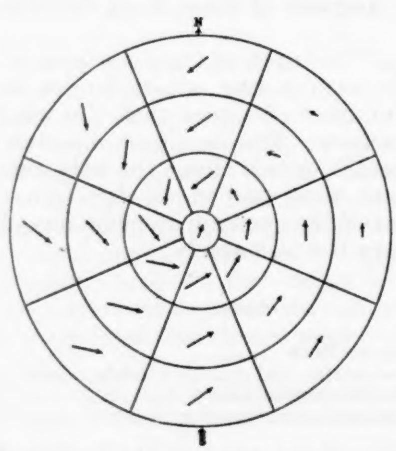

FIG. 9.—Direction of motion of nimbus and stratus clouds in cyclones at Davenport.

length of the arrow indicates the constancy with which the wind blows in the given direction. The broken arrows indicate that the directions in the subarea where such arrows occur are based upon five observations or

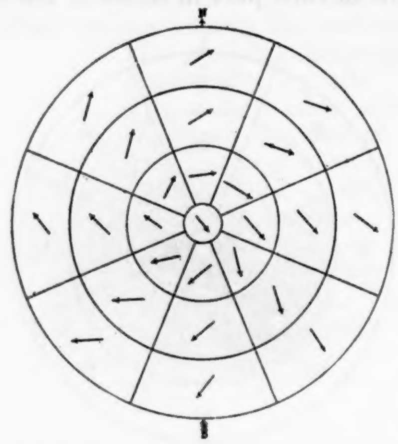

FIG. 10.—Direction of surface winds in anticyclones at Davenport.

less. Observations are lacking in the subareas which have no arrows.

Direction of motion of surface winds.—The resultant direction of the surface wind in each of the subareas of

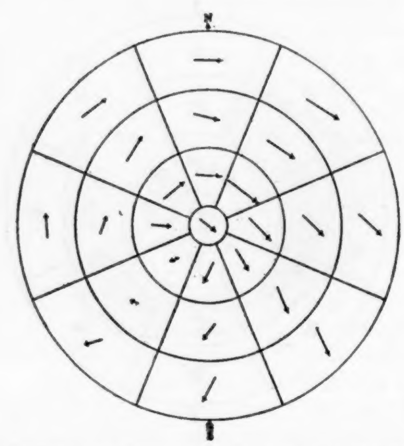

FIG. 11.—Direction of motion of nimbus and stratus clouds in anticyclones at Davenport.

cyclones, overlying Davenport, is shown in Figure 8. The arrows exhibit the characteristic anticlockwise spiral motion of the air in cyclones. Also, the direction

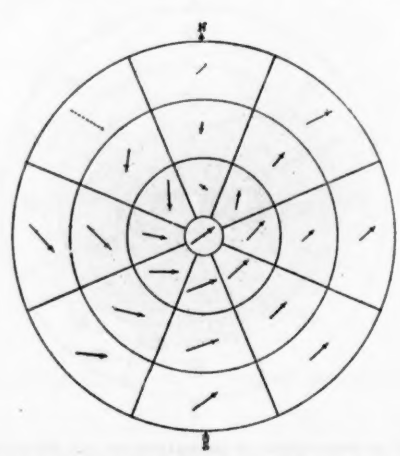

FIG. 12.—Direction of motion of cumulus, strato-cumulus, and cumulo-nimbus clouds in cyclones at Davenport.

of the wind becomes increasingly tangential on approaching the center. The resultant direction of the wind in

the central area is from the south, with a slight westerly component.

Direction of motion of nimbus and stratus clouds.—The nimbus and stratus cloud directions shown in Figure 9, likewise possess the spiral motion characteristic of the surface winds. In addition, the winds at this altitude exhibit a westerly trend, noticeable on the eastern side of the cyclonic diagram. In subareas 4, 12, 20 and 5, 13, and 21, for example, the arrows are rotated toward the east from their direction in the surface chart, by almost 45°. The wind direction in the central subareas pos-

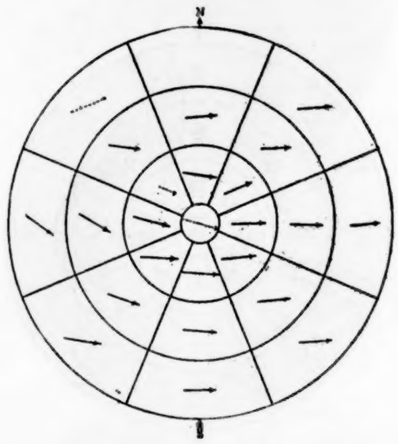

FIG. 13.—Direction of motion of alto-stratus and alto-cumulus clouds in cyclones at Davenport.

sesses a greater westerly component than do the surface winds.

Direction of motion of cumulus, strato-cumulus, and cumulo-nimbus clouds.—These appear to represent an intermediate condition between the lowest and the highest winds. The arrows in Figure 12 do not possess the complete spiral arrangement characteristic of the two previous levels. Nevertheless the winds at this altitude clearly show the effect of the cyclonic whirl.

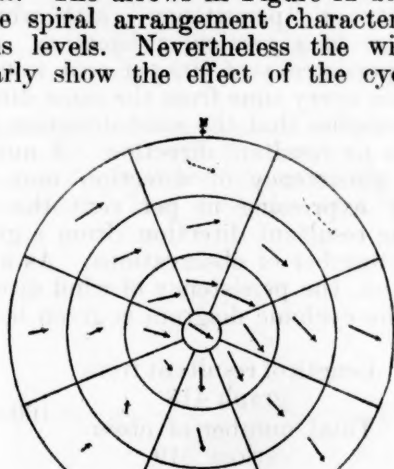

FIG. 14.—Direction of motion of cumulus, strato-cumulus and cumulo-nimbus clouds in anticyclones at Davenport.

The westerly trend of the winds is here very marked in all the areas, including the central one.

Direction of motion of alto-stratus and alto-cumulus clouds.—Except for a slightly southerly convexity in their arrangement, the arrows in Figure 13 do not exhibit any marked effect of the rotary motion of the cyclonic winds. The diagram shows that the alto-stratus and alto-cumulus clouds proceed almost always from a westerly direction regardless of the region of the cyclone in which the clouds occur.

Direction of motion of cirrus, cirro-stratus, and cirro-cumulus clouds.—This is the highest group of clouds. As in the previous case, the arrows exhibit a southward convexity (see fig. 16). The clouds proceed quite regularly from the west in all the areas of the cyclone.

The diagrams, just described, show that the rotary motion of cyclones certainly extends upward to the nimbus and stratus clouds. In most cyclones the rotary motion probably reaches the cumulus group of clouds, and perhaps higher. At this altitude, however, the westerly winds, whose effect is already apparent at the

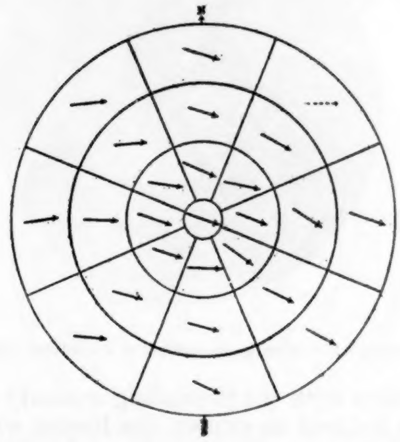

FIG. 15.—Direction of motion of alto-stratus and alto-cumulus clouds in anticyclones at Davenport.

nimbus level, become very marked. At the alto-stratus and cirrus levels the westerly winds proceed almost unhampered by the cyclonic whirl below, whose only effect is to produce a slight southward convexity in the arrangement of the arrows.[3]

WIND VELOCITIES.

The average wind velocity which Davenport experiences in each of the subareas of the cyclonic diagram is

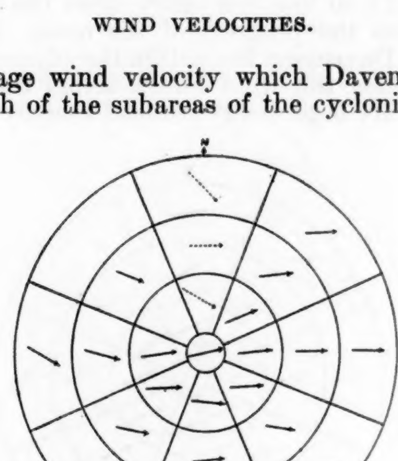

FIG. 16.—Direction of motion of cirrus, cirro-stratus, and cirro-cumulus clouds in cyclones at Davenport.

shown in Figure 17. Several variations in velocity are apparent. In the first place the velocity increases radially inward to a maximum at the innermost concentric

[3] The author's conclusion here is reached apparently upon the basis of a sea-level distribution of pressure and upon the assumption that that distribution is reproduced vertically. It is well known that in most cyclones, especially in winter, the center of lowest pressure at free-air levels is displaced farther and farther toward the colder region with increase of elevation. Thus, the pressure distribution actuating the movement of the higher clouds is not the same as that at the surface or at the level of lower clouds. The conclusion, therefore, that the cyclone does not extend to the cirrus level, based upon the simultaneous observation of surface pressure and the direction of cirrus movement, is hardly tenable.—EDITOR.

ring of subareas, dropping quickly to a value of 7.9 miles per hour in the central area. This is readily seen in Figure 20, in which the velocities are represented on ordinates erected at the centers of subareas lying along four diameters of the cyclonic diagram.

Secondly, the highest wind velocities occur southwest of the central area, where the cyclonic winds below coincide in direction with the prevailing westerly winds above. It would be natural to expect the lowest wind velocities northeast of the central area where the surface cyclonic winds are opposed to the westerly winds above. Instead, comparatively high velocities prevail in this region, with lower wind velocities on either side. The local topography may bring about the condition just described. When Davenport is situated within the regions of highest velocities, the direction of the surface wind is approximately parallel with the valley of the river (compare figs. 8 and 17), so that the valley offers the least possible obstruction to the progress of the wind. On the other hand, when Davenport lies within the adjacent regions of lower velocities, the wind blows across the river valley and its velocity is probably reduced thereby.

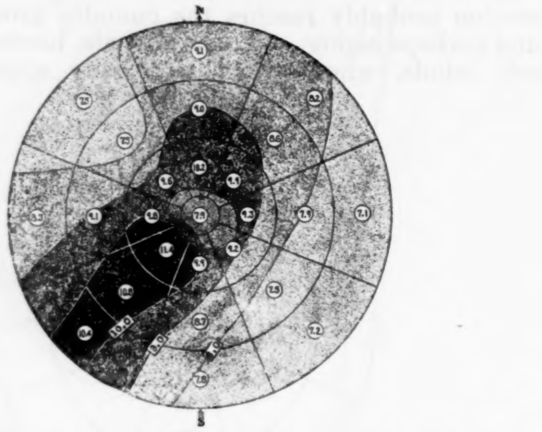

FIG. 17.—Average wind velocities in cyclones at Davenport (miles per hour).

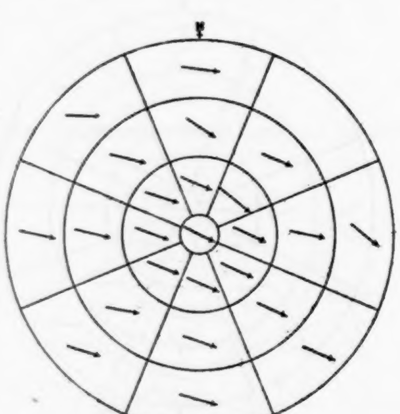

FIG. 18.—Direction of motion of cirrus, cirro-stratus, and cirro-cumulus clouds in anticyclones at Davenport.

PERSISTENCY OF WINDS AND CLOUD MOVEMENTS.

In certain parts or cyclonic areas the wind blows with great regularity from a particular direction, while in other parts the wind direction is extremely variable. This fact is apparent from the following table, which shows the wind directions recorded at Davenport when the city was situated in subareas 1 and 15 of the cyclonic diagram.

	Wind direction.	No. of subarea. 1	15
Number of times wind blew from each direction indicated....	N.	7	9
	NE.	9	1
	E.	17	3
	SE.	15	3
	S.	21	7
	SW.	29	96
	W.	14	245
	NW.	7	155
Total number of observations	....	119	519

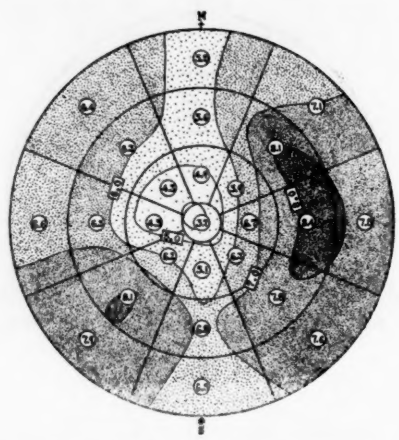

FIG. 19—Average wind velocities in anticyclones at Davenport (miles per hour).

When Davenport lay in area 15 the wind blew almost always from the southwest, west or northwest, 496 out of 519 times. On the other hand when the city lay in the central cyclonic area, No. 1, the wind was extremely variable in direction.

It appears desirable to obtain a numerical measure of the regularity or "persistency" with which the wind tends to blow in a particular direction. Expressed in per cent, a persistency of 100 per cent would mean that the wind blew every time from the same direction. Zero persistency implies that the wind direction is so variable that there is no resultant direction. A numerical measure of the persistency of direction may therefore be obtained by expressing in per cent the ratio of the length of the resultant direction (from a graphical plot) of the total number of observations. As an illustration to the method, the persistency of wind direction in subarea 15 of the cyclonic diagram is given below.

$$\text{Persistency} = \frac{\text{Length of resultant from graph } 418}{\text{Total number of observations } 519} \times 100 = 81 \text{ per cent.}$$

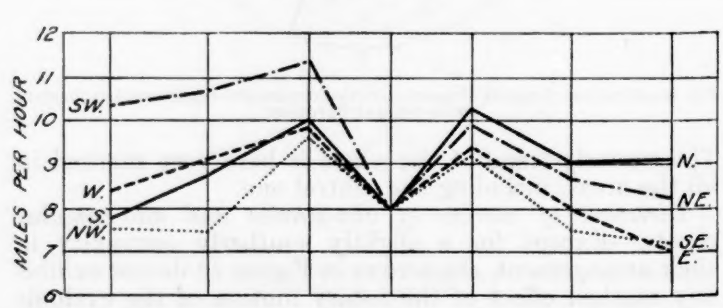

FIG. 20.—Radial variation in wind velocities in a cyclone at Davenport. The figures at the side give the velocities in miles per hour. The vertical line in the center is erected on the center of the cyclone. The two lines next outside rise from the centers of subareas 2 to 5 and 6 to 9, respectively; the next outer lines from subareas 10 to 13, and 14 to 17, etc. See fig. 1 for location of subareas.

In the wind direction diagrams 8, 12, 13, and 16, the lengths of the arrows were made proportional to the persistency of the wind direction in each subarea.

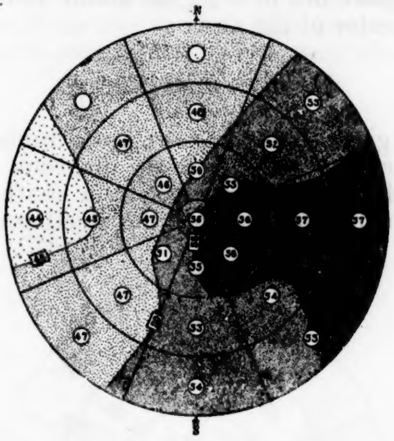

FIG. 21.—Distribution of temperature in cyclones at Davenport (°F.).

Irregular topographic features probably affect the surface wind persistencies. In the main, however, the

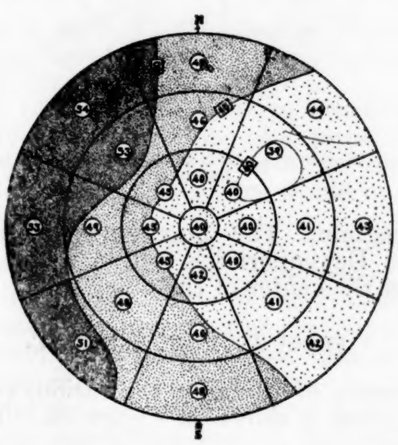

FIG. 22.—Distribution of temperature in anticyclones at Davenport (°F.).

surface persistency values are determined by the cyclonic motion of the wind. This gives rise to a region of high

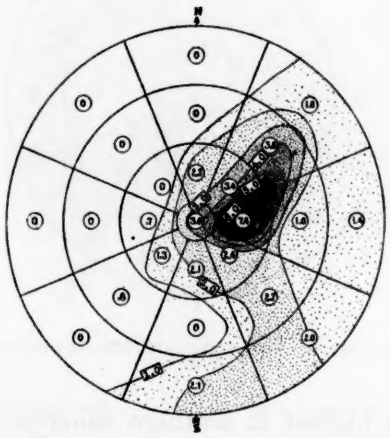

FIG. 23.—Frequency of thunderstorms in cyclones at Davenport. Numbers in subareas represent the number of thunderstorms per 100 times that Davenport falls within a given subarea.

persistency values southwest of the center and lower persistencies to the northeast. At the height of the nimbus, stratus and cumulus groups of clouds these two regions of high and low persistency are sharply defined, clearly indicating that the cyclonic motion extends to this height. High persistency values prevail in all areas at the alto and the cirrus levels, due to the prevailing westerly winds.

RESULTANT VECTORS AND WESTERLY COMPONENTS OF ALL WIND MOVEMENTS AT FIVE DIFFERENT LEVELS.

Finally we may combine the 25 resultant wind directions at a given level into a single total resultant direction for that altitude. In this way five total resultant wind directions have been obtained, one for each level.

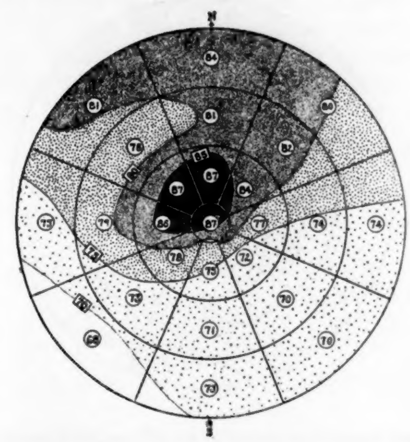

FIG. 24.—Average distribution of relative humidity in cyclones at Davenport.

These resultant wind directions are indicated by the broken lines in Figure 46. The full lines in this figure represent the westerly components of the resultant directions at the respective levels. The approximate altitudes of the respective wind levels is given along

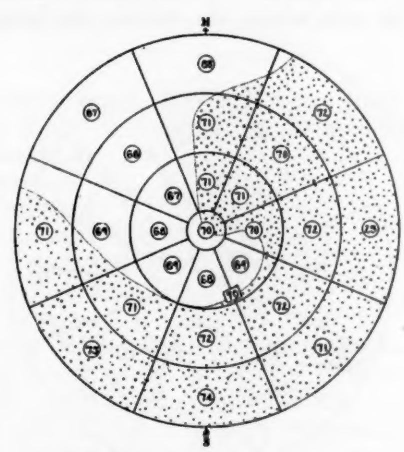

FIG. 25.—Average distribution of relative humidity in anticyclones at Davenport.

the ordinate, while the persistency of the westerly components is measured along the abscissa. This is as below.

	Westerly component persistency in per cent.
1. Surface wind	5.0
2. Nimbus and stratus	19.4
3. Cumulus, strato-cumulus and cumulo-nimbus	45.7
4. Alto-stratus and alto-cumulus	82.4
5. Cirrus, cirro-stratus and cirro-cumulus	82.5

It is seen that the 25 surface winds of the cyclonic diagram, when combined into a single vector, possess

a slight westerly component. This component is small because at the surface the cyclonic motion of the winds is most pronounced. With increase in altitude the cyclonic motion decreases and the westerly winds increase in strength. The curved line in Figure 46 shows graphically this increase in the total resultant westerly component of the wind direction as the altitude increases.

TEMPERATURE.

The average temperature which Davenport experiences in each of the cyclonic subareas is shown in Figure

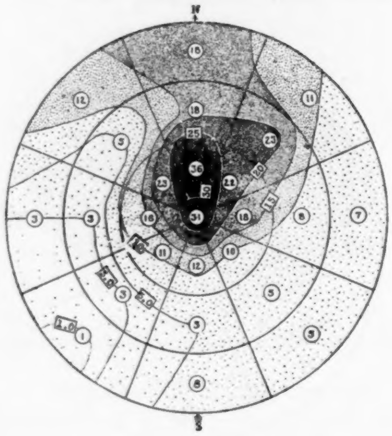

FIG. 26.—Percentage frequency of rainfall in the different subareas of cyclones at Davenport.

21. The temperatures represent the arithmetical average based on the total number of observations, morning and evening, for the respective subareas. The distribution of temperatures is such as we might expect within a cyclone. The higher temperatures occur on the eastern side where the winds are from the south and the lower temperatures on the western side where the winds are from the north.

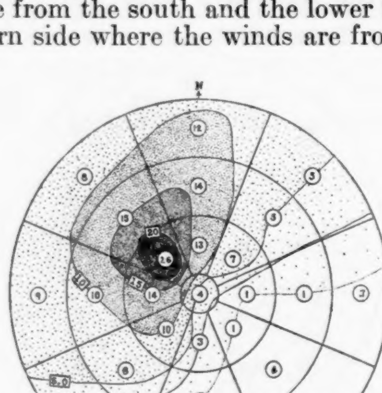

FIG. 27.—Percentage frequency of snowfall in the different subareas of cyclones at Davenport.

FREQUENCY OF THUNDERSTORMS.

The percentage frequency of thunderstorms in the various parts of cyclonic areas is given in Figure 23. There are on the average 3.6 thunderstorms for every 100 times that Davenport falls within the central region. This result, like all others in this paper, is based on the morning and evening observations throughout the entire period under consideration. The percentage frequency of thunderstorms would no doubt be greater for the summer season and less for the winter months.

The diagram shows that thunderstorms frequently occur on the eastern side of LOWS and are almost lacking on the western side. Thunderstorms are most frequent when Davenport lies in a region about 100 to 300 miles east of the center of the LOW.

RELATIVE HUMIDITY.

Figure 24 gives the average relative humidity for each of the subareas of the cyclonic diagram. The lowest values of relative humidity occur in southern subareas while high values prevail in the northern half of the

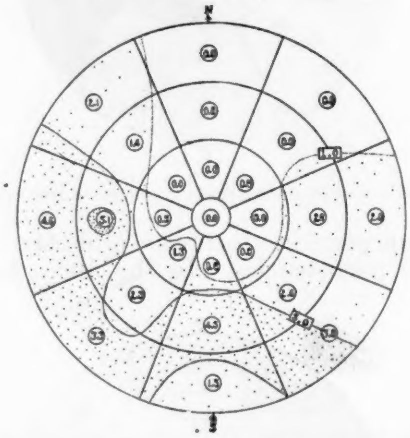

FIG. 28.—Percentage frequency of rainfall in the different subareas of anticyclones at Davenport.

cyclonic diagram. The maximum relative humidity occurs when Davenport lies within a small region just northwest of the center of the diagram.

FREQUENCY OF RAINFALL.

This frequency of rainfall in the various subareas of the cyclonic diagram is shown in Figure 26. The frequency

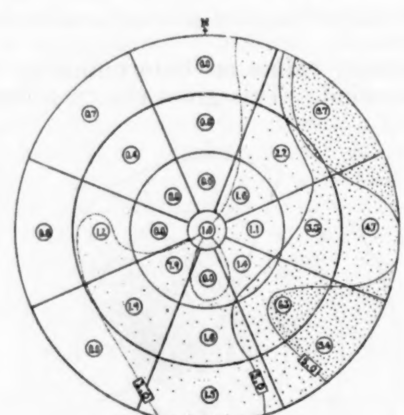

FIG. 29.—Percentage frequency of snowfall in the different subareas of anticyclones at Davenport.

of rainfall is highest in northern subareas, and, in particular, rainfall is most frequent at Davenport when the city lies within a region extending from 300 miles northward from the center of the cyclonic diagram. In subarea 2 where the frequency is greatest, it rains on the average 36 out of 100 times. The frequency of rainfall is least in the southern subareas, the minimum frequency occurring in 23, southwest of the center.

FREQUENCY OF SNOWFALL.

This is pictured in Figure 27. Snowfall rarely occurs southeast of the center of the cyclonic diagram, where the winds are from the south. The frequency of snowfall is high in the northwestern subareas, where the winds

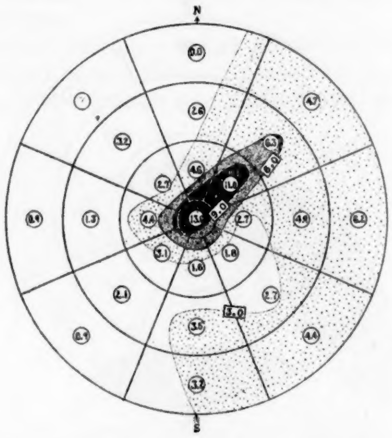

FIG. 30.—Percentage frequency of fogs in cyclones at Davenport.

are from the north. The maximum frequency occurs when Davenport is situated in a small region just northwest of the center of the LOW.

The region of maximum relative humidity coincides approximately with the regions of greatest frequency of rainfall and snowfall. If the latter two diagrams were combined into one this coincidence would be all the more apparent.

Textbooks frequently refer to the region southeast of the center of the cyclone as the rain-bearing area. This may be true for certain parts of the United States and perhaps for other countries. For Davenport, however, it seems certain that the principal rainfall region lies north of the center of a LOW. This may be due in a large measure to the presence of the Great Lakes and other bodies of water north and east of Davenport. Winds blowing over these regions have a chance to become moisture laden before reaching Davenport. On the other

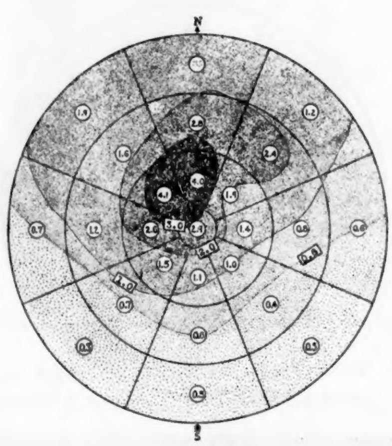

FIG. 31.—Percentage frequency of nimbus clouds in cyclones at Davenport.

hand winds coming from the south and west do not traverse any large water surfaces and this may in part account for the low rainfall frequency south and west of the center of the cyclonic diagram.[4]

FREQUENCY OF FOGS.

Fogs are decidedly more frequent when Davenport is situated on the eastern side of a LOW than on the western side. This is clearly seen in Figure 30. Maximum frequency occurs at the center of the cyclonic diagram in a region which extends several hundred miles to the northeast. In the central region fogs occur 13 out of every 100 times that Davenport lies in this area.

It has been frequently noticed that light fogs on the uplands around Davenport may become very dense upon descending a short distance into the valley below. The occurrence of fogs in this locality is no doubt closely related to the presence of the river. Light winds blowing parallel with the direction of the river would probably favor the formation of fogs. In subareas 3 and 11 where the frequency is high, the direction of the wind is approximately parallel with the direction of the river valley.

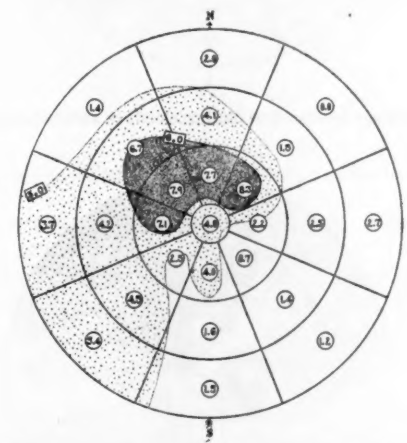

FIG 32.—Percentage frequency of fogs in anticyclones at Davenport.

DISTRIBUTION OF CLOUDINESS IN CYCLONES AT DAVENPORT.

The following types of clouds have been studied with reference to their distribution in the cyclonic diagram:

1. Nimbus
2. Stratus.
3. Cumulus.
4. Alto-cumulus.
5. Alto-stratus.
6. Cirro-stratus.
7. Cirrus.

On account of the small number of observations the other cloud forms were omitted. Following the usual practice, the amount of cloudiness has been designated by the scale of 1 to 10, where 10 represents total cloudiness, when the sky is overcast.

Nimbus cloudiness.—The amount of nimbus cloudiness is least in the southern areas of the cyclonic diagram and increases toward the north (fig. 31). The region of maximum nimbus cloudiness occurs north and slightly west of the center of the cyclonic diagram. This diagram should be compared with figures 24, 26, and 27. Naturally the region of greatest nimbus cloudiness coincides with the regions of maximum relative humidity, rainfall, and snowfall frequency.

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[4] The distribution here shown conforms closely with that of Bjerknes's typical cyclone (cf. MO. WEATHER REV., February, 1919, 47: 95-99) and therefore local conditions seem to play but a minor rôle.—EDITOR.

Stratus cloudiness.—The distribution of the stratus clouds (fig. 34) is quite similar to that of the nimbus clouds. The region of maximum stratus cloudiness, however, broadens out toward the north. Also, the average amount of stratus cloudiness is greater than for the nimbus clouds.

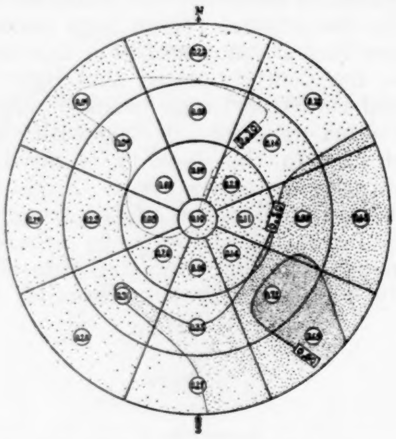


FIG. 33.—Percentage frequency of nimbus clouds in anticyclones at Davenport.

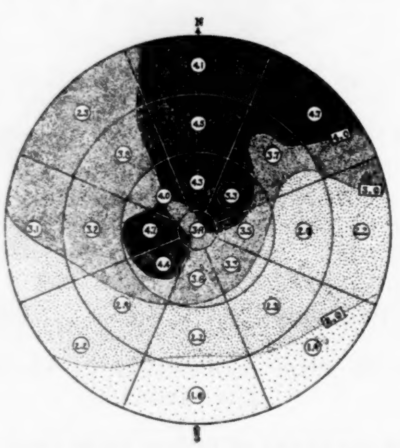


FIG. 34.—Percentage frequency of stratus clouds in cyclones at Davenport.

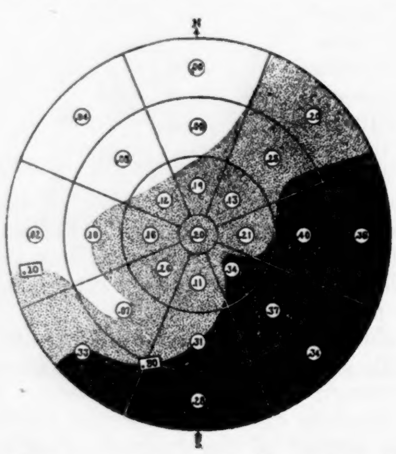


FIG. 35.—Percentage frequency of cumulus clouds in cyclones at Davenport.

Cumulus cloudiness.—The cumulus clouds occur mainly southeast and east of the center of the LOW, as shown in figure 35. This was to be expected inasmuch as convection is very pronounced in this part of the cyclone.

Alto-cumulus.—The distribution of alto-cumulus clouds in the cyclonic diagram is shown in Figure 38. On account of the small number of observations for the higher clouds, this and the remaining cyclonic diagrams present many irregularities in their appearance. Only the more general features of the diagrams are therefore considered significant. The alto-cumulus clouds are most common on the eastern side of the cyclone. The average amount of this kind of clouds is seen to be very small.

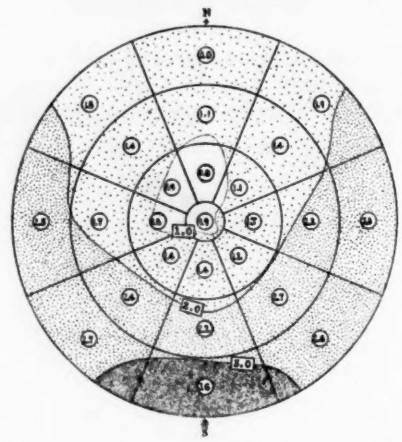


FIG. 36.—Percentage frequency of stratus clouds in anticyclones at Davenport.

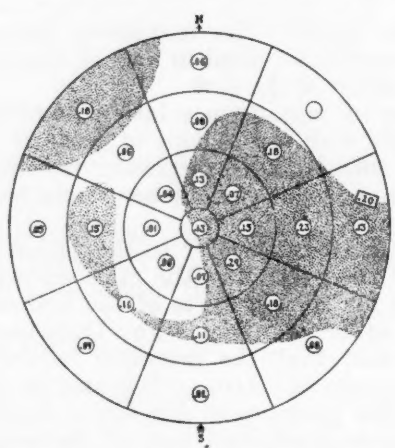


FIG. 37.—Percentage frequency of cumulus clouds in anticyclones at Davenport.

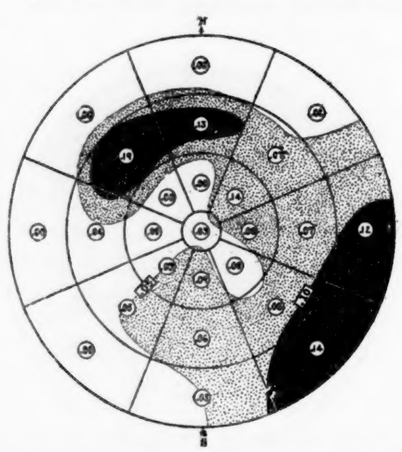


FIG. 38.—Percentage frequency of alto-cumulus clouds in cyclones at Davenport.

Alto-stratus cloudiness.—The alto-stratus clouds (fig. 39) likewise are present chiefly on the eastern side of the cyclonic diagram. These clouds are present in fairly high frequency, the highest average value of the cloudiness being approximately equal to 1.

Cirro-stratus cloudiness.—The cirro-stratus clouds also occur mainly on the eastern side of the low. The aver-

age cirro-stratus cloudiness is slightly less than the alto-stratus. (See fig. 42.)

Cirrus cloudiness.—The amount of cirrus clouds is very small and the clouds are most prevalent in the eastern subareas of the cyclonic diagram. (See fig. 43.)

With regard to their distribution in the cyclonic diagram the clouds here described may be divided into three large groups.

1. The approximately similar distribution of nimbus and stratus cloudiness is closely related to the distribution of precipitation and relative humidity at the surface.

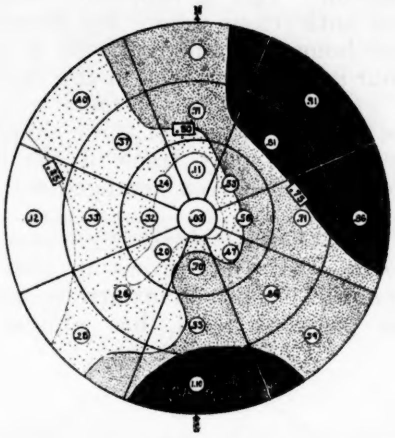


FIG. 39.—Percentage frequency of alto-stratus clouds in cyclones at Davenport.

2. The cumulus cloud distribution toward the southeast is such as to favor the accepted theory of their convectional origin.

3. The alto-cumulus, alto-stratus, cirro-stratus and cirrus clouds occur at high altitudes. In all cases under this third group the amount of cloudiness is greatest in the eastern and least on the western side of the cyclonic diagram.

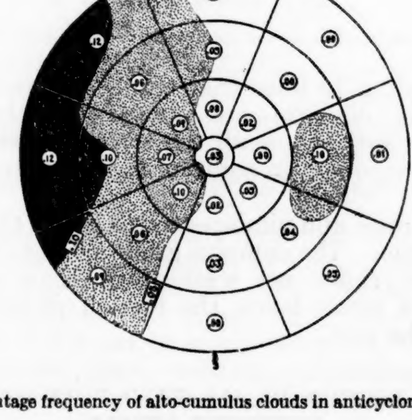


FIG. 40.—Percentage frequency of alto-cumulus clouds in anticyclones at Davenport.

SURFACE AND UPPER AIR CONDITIONS IN ANTICYCLONIC SUBAREAS OVERLYING DAVENPORT, IOWA.

The average weather conditions at Davenport, when situated in particular regions of anticyclones, have been studied in the same manner as for cyclones. The results of this study will be briefly presented in the following paragraphs, together with a comparison of the weather conditions in some regions of the cyclonic diagram. The same diagram of 25 subareas was used for studying both the HIGHS and LOWS.

NUMBER OF OBSERVATIONS IN DIFFERENT SUBAREAS OF ANTICYCLONES.

A comparison of Figure 5 and Figure 3 show that the distribution of the number of observations in the anticyclonic diagram is in one respect similar to the distribution in the cyclonic diagram. In each instance there is a crescent-shaped area below the center of the diagram

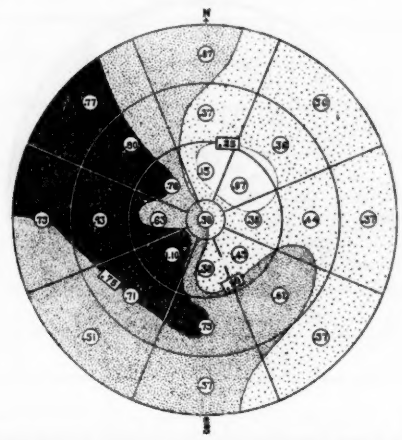


FIG. 41.—Percentage frequency of alto-stratus clouds in anticyclones at Davenport.

containing two maxima of observations. The total number of observations in the different parts of anticyclones, namely, 5,286, is 986 more than in the cyclonic diagram. The observations in the anticyclonic diagram are somewhat more evenly distributed among all the different areas of the anticyclone than are the observations in the cyclones.

Frequency of observations.—This has previously been defined as the number of observations per unit of area in each subdivision. It will also be remembered that the frequency values depend upon the directions of the paths traversed by anticyclones in passing over Davenport in such a way that the frequency areas become elongated in a direction parallel to the paths of the HIGHS. The frequency areas in Figure 6 are elongated from east to

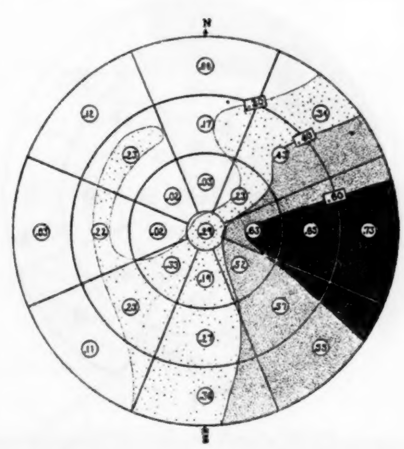


FIG. 42.—Percentage frequency of cirro-stratus clouds in cyclones at Davenport.

west with a slight dip toward the southeast. This is the prevailing direction of the paths of anticyclones at Davenport. Finally, the figure also shows that anticyclones pass with almost equal frequency north and south of Davenport.

DIRECTION OF THE SURFACE WINDS AND THE CURRENTS IN THE UPPER AIR IN ANTICYCLONES.

Surface winds.—The resultant direction of the surface wind at Davenport when the city is situated in the various subareas of the anticyclonic diagram is shown in Figure 10. The arrows exhibit the usual clockwise

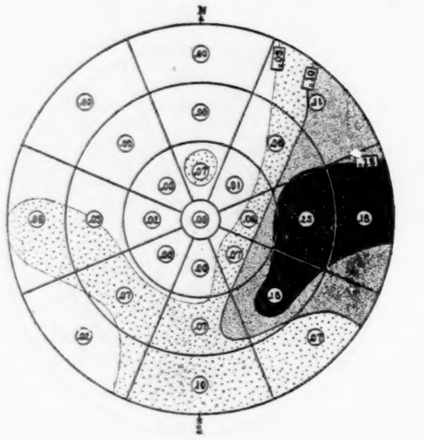


FIG. 43.—Percentage frequency of cirrus clouds in cyclones at Davenport.

arrangement characteristic of anticyclonic winds. In the central region the resultant wind direction is northwest.

Direction of motion of nimbus and stratus clouds.—Compared with Figure 10 it will be seen that many of the arrows in Figure 11 have been rotated toward the east, especially in the northwest of the diagram, clearly showing the effect of the prevailing westerly winds at this altitude. Nevertheless, the regular clockwise arrangement of the arrows indicates that the anticlockwise motion is predominant at the height of the nimbus and stratus clouds.

Direction of motion of cumulus, strato-cumulus and cumulo-nimbus clouds.—The anticyclonic motion of the air, although very evident at this height, appears to be breaking up. (See fig. 14.) The effect of the westerly

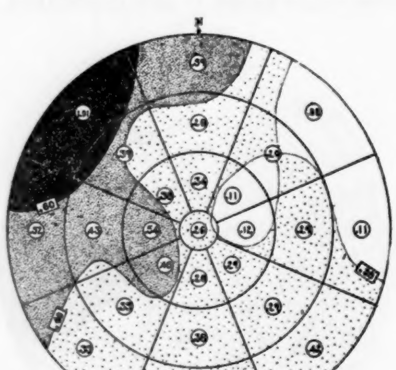


FIG. 44.—Percentage frequency of cirro-stratus clouds in anticyclones at Davenport.

winds is more noticeable than in the previous figure. The diagram suggests a transitional stage between the anticyclonic motion below and the westerly winds above.

In the central region the resultant wind direction is from the northwest, becoming more westerly at the higher altitudes. Comparing this with the cyclonic diagram, it is seen that the wind direction in the central region of the cyclone is now from the southwest and becomes more westerly with increasing altitude.

Wind velocity.—The average wind velocity which Davenport experiences in each of the subdivisions of the anticyclone is shown in Figure 19. The radial variation in velocity is very apparent from Figure 47. Naturally the velocity is least in the central region. Steep pressure gradients usually occur in front of winter anticyclones, and this is probably the cause of the region of high velocity in the eastern parts of the cyclonic diagram.

The average wind velocities throughout the anticyclonic diagram are considerably less than in the cyclonic diagram. This is especially noticeable at the center of the anticyclone where the average velocity is 3.7 miles per hour as compared with a velocity of 7.9 miles per hour in the same area in the cyclonic diagram.

Direction of motion of alto-stratus and alto-cumulus clouds.—The average motion of these clouds is distinctly from the west. The only trace of the cyclonic whirl below is the upward convex arrangement of the arrows (fig. 15).

Direction of motion of cirrus, cirro-stratus, and cirro-cumulus clouds.—All the arrows in this diagram are practically parallel. The convex arrangement, characteristic of the previous level, has almost disappeared.

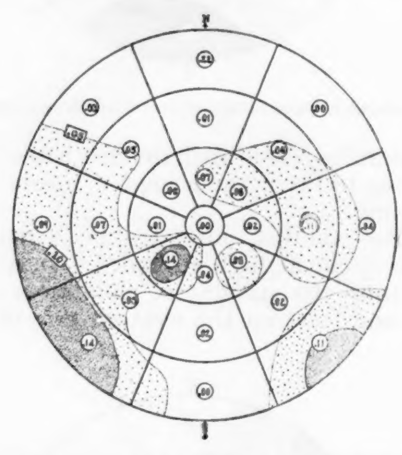


FIG. 45.—Percentage frequency of cirrus clouds in anticyclones at Davenport.

It is interesting to note that while the cirrus clouds in the cyclonic diagram are almost directly from the west, in the anticyclone all the arrows possess a definite northerly component in addition to the westerly direction (fig. 18).

At the surface and nimbus-stratus levels the air motion is anticyclonic. The cumulus group of clouds are neither clearly anticyclonic nor westerly in their motion. At the alto and cirrus levels the motion of the air is distinctly to the east.

RESULTANT VECTORS OF ALL WIND MOVEMENTS AT FIVE DIFFERENT LEVELS.

The total resultant wind direction and persistency for Davenport at each of the five levels is shown by the broken arrows in Figure 48. With increasing altitude the total resultant wind directions become more westerly. The westerly components of the resultant directions are shown by the heavy lines, and the persistency of these components is given below.

Surface wind	9.0
Nimbus-stratus	29.7
Cumulus group	48.4
Alto group	78.0
Cirrus group	79.7

The curved line in Figure 48 shows graphically the increase in the westerly component of the total resultant directions for the respective levels.

Figures 46 and 48 are quite similar. In both diagrams the westerly components reach a maximum at about the elevation of the alto-stratus and alto-cumulus group of clouds. The diagrams suggest that the principal effect of the rotary motion of cyclones and anticyclones extend on the average to about this height.

TEMPERATURE.

The average temperature for Davenport in each of the anticyclonic subdivisions is given in Figure 22. The highest temperature values occur west of the center of the diagram where the winds are from the south while the lowest occur east of the center where the winds are from the north.

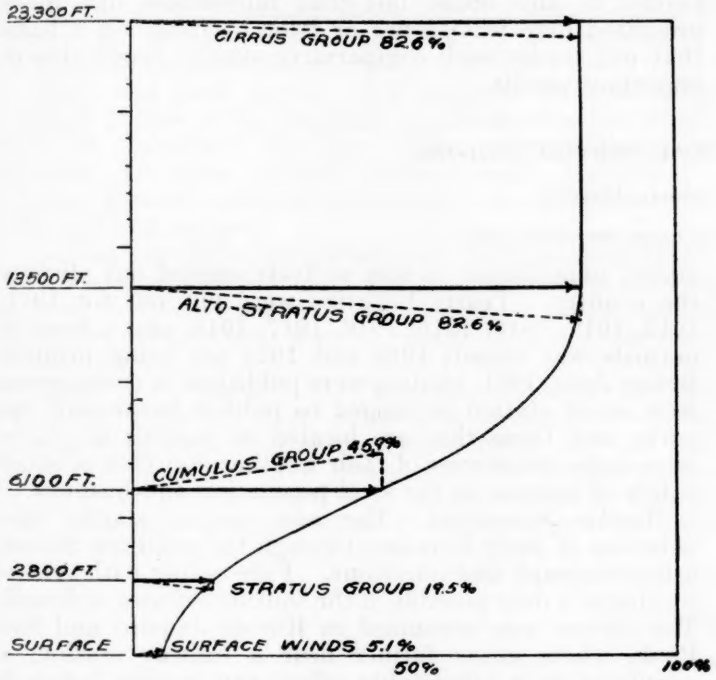


FIG. 46.—Resultant vectors and westerly component of all winds and cloud movements at each of five different levels in a cyclone at Davenport.

FREQUENCY OF THUNDERSTORMS.

Thunderstorms are naturally quite rare in anticyclones. When they do occur it is mainly in western regions where the temperatures are highest. The greatest frequency recorded is subarea 23, where thunderstorms occur, on the average, 1.1 out of every 100 times that Davenport lies within that subarea. Thunderstorms are almost lacking on the western side of the cyclone and on the eastern side of the anticyclone where the winds are from the north.

RELATIVE HUMIDITY.

Figure 41 gives the average relative humidity for Davenport in each part of the anticyclonic diagram. The relative humidity is seen to be greatest when Davenport is situated in the southern and the eastern part of the diagram, respectively, and least in the northern part. In the cyclonic diagram almost the reverse is true. The relative humidity is there least in the southern and greatest in the northern part.

FREQUENCY OF RAINFALL.

The frequency of rainfall at Davenport, when the city is situated in an anticyclone, is greatest in the southern part of the diagram and least in the northern (fig. 28). The frequency values are quite low, the highest being 5.1 rainfall occurrences per 100 observations in subarea 16.

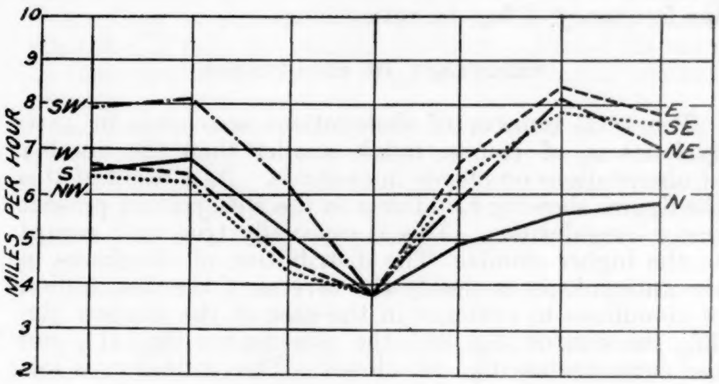


FIG. 47.—Radial variation in wind velocities in an anticyclone at Davenport. For explanation of the construction of the figure see fig. 20.

FREQUENCY OF SNOWFALL.

In the anticyclonic diagram the greatest frequency of snowfall (fig. 29) occurs when Davenport lies in the subareas southeast of the center of the diagram where the winds are from the north. The least frequency of snowfall is found in the subareas northwest of the center of the diagram where the winds are from the south. The

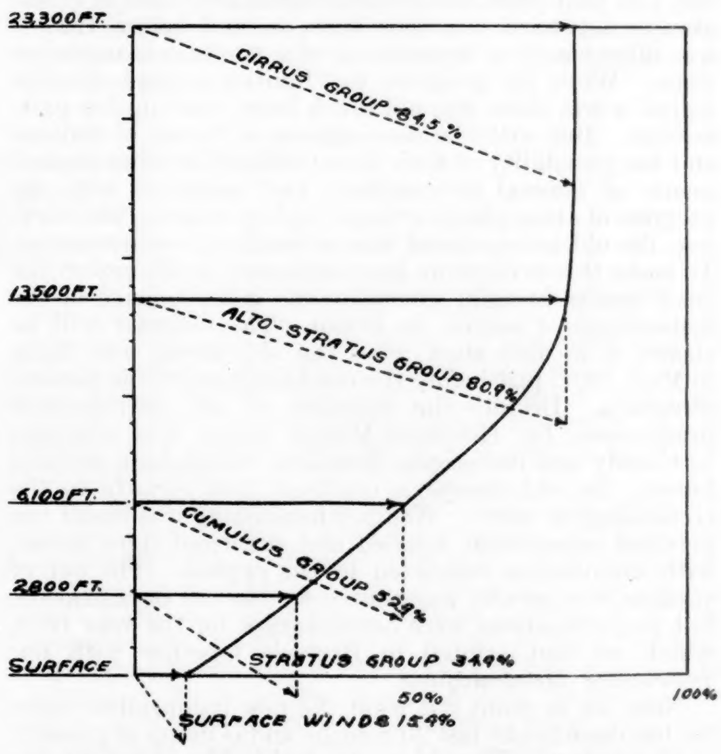


FIG. 48.—Resultant vectors and westerly component of all winds and cloud movements at each of five different levels in an anticyclone at Davenport.

high frequencies southeast of the center of the anticyclonic diagram match the high frequencies northwest of the center of the cyclonic diagram. In both these cases the winds have the same general direction.

FREQUENCY OF FOGS.

In the anticyclones, as in the cyclones, the distribution of the frequency of fogs for Davenport seems rather erratic. On the whole, fogs are least frequent in the east half of the anticyclone where the winds are from the north (fig. 32). The area of greatest frequency lies in subareas 2, 3, 8, 9, and 17. It is quite likely that the presence of the Mississippi River affects, to some extent, the frequency of fogs in anticyclones.

FREQUENCY OF CLOUDINESS.

The total number of observations on clouds in anticyclones is, of course, much smaller than the number of observations on clouds in cyclones. As a result of this the figures showing cloudiness in the anticyclones present many irregularities. This is especially true with regard to the higher clouds. The distribution of cloudiness in the anticyclones is clearly the reverse of the distribution of cloudiness in cyclones in the case of the nimbus (fig. 33), the stratus (fig. 36), the alto-stratus (fig. 41), and the cirro-stratus (fig. 44) clouds. This condition is less evident in case of the alto-cumulus (fig. 40) and the cirrus (fig. 45) clouds, and it can not be said to be at all noticeable in the chart for the cumulus clouds (fig. 37). Averages based on a larger number of observations must be expected to change some of these charts.

CONCLUSION.

In this paper, the author has limited himself mostly to statements of facts supplementary to the illustrations. This was done in the belief that a fuller discussion of the elements of the weather, in any single locality, can best be made after other studies, like these, shall have been worked out for other places, representing several climatic regions in our country. Such studies would enable us to make comparisons from which we could infer, with greater confidence than we can do now, the causes of distribution of weather elements. With the wealth of material at hand for such studies, there can hardly be any doubt but that tabulations like those presented here will sooner or later be made on a basis that will render such comparative studies productive of important results.

BRAZILIAN METEOROLOGICAL SERVICE (1921-1923.)

By J. DE SAMPAIO FERRAZ, Director.

[Directoria de Meteorologia, Rio de Janeiro, February 16, 1923.]

Deeming it of some interest to other meteorological organizations of the world, we have prepared for their benefit a short resumé of the work done in the last 20 months by the new Brazilian Meteorological Service, created in June, 1921. As explained in our Foreign Circular No. 1 of that year, the meteorological activities in Brazil always depended on other bureaus, and before 1921 it was often simply a department of astronomical organizations. While the program was limited to pure climatological work, there was not much harm done in this partnership. But with the development of the net of stations and the possibility of their being utilized in other departments of general meteorology, and moreover with the progress of atmospheric science, rapidly creating new services, the old arrangement was certainly an inconvenience. To make this evident we have indicated in this report the good results brought about by the independence of the meteorological service in Brazil. The contrast will be clearer if we first show what the old service was doing in May, 1921, just before the establishment of the present directoria. Despite the direction of my distinguished predecessor, Dr. Henrique Morize, whose first attempts to classify and investigate Brazilian climatology are well known, the old directoria confined itself strictly to the climatological work. Weather forecasting was under our personal supervision, studied and practiced *intra muros*, with distribution restricted to the capital. The net of stations was greatly augmented by the old organization, but no publications were issued except for the year 1910, which we had printed in Brussels together with our *Instrucções Meteorologicas*.

Now, let us point out what the new independent service has done in the last 20 months and is doing at present.

Climatology.—The old service had in May, 1921, 51 stations of second order, 46 of third order, 31 pluviometric, and 26 cooperative. The new bureau has now 74 stations of second order, 78 of third order, 57 pluviometric, and 180 cooperative. Inspection, which was previously almost nonexistant, is now actively carried out all over the country. Yearly bulletins were put out for 1911, 1912, 1913, 1914, 1915, 1916, 1917, 1918, and a book of normals was issued; 1919 and 1920 are being printed. Before June, 1921, no data were published in newspapers. Now every station is obliged to publish two-weekly reports, and those that are located in capitals of States issue daily summaries of their weather and that of other points of interest to the local population and business.

Weather forecasting.—The new service started distribution of daily forecasts through the southern States, using telegraph and telephone. Forecasting with synoptic charts is only possible in the southern States of Brazil. The service was organized in Rio de Janeiro and São Paulo where every farmer near a railway station, a telephone or a telegraphic office, can receive before 6 o'clock in the evening the official forecasts for the next 24 hours. Santa Catharina and Parana are being prepared to have the same service this year. In the large towns the weather forecasts are distributed by flags.

Several storm warning towers were put up on the southern coast. All the radio stations of the coast, 12 in number, broadcast every 4 hours the weather of the occasion, the wind direction and speed being given by automatically recording instruments. Rio's radio station gives out special bulletins with data of chosen points and the forecasts for weather of night and day. Forecasts are also sent out by radio telephone from Corcovado (Rio).

The Brazilian isobaric charts are constructed from reports of 80 Brazilian stations (from Bahia to Rio Grande), 18 Argentine stations and 6 from Uruguay. On account of the very variable topography of the country and its extensive high plateaus, winds and pressures can only be rightly interpreted with long experience, and in many cases are very troublesome to the forecasters. New processes based on these elements can not be followed in Brazil. Our own empirical rules had

to be discovered and applied. These will be described in a memoir which is being prepared on *Forecasting in Brazil.*

All the above services were started by the new office since June, 1921.

Agricultural meteorology.—Brounov's type of stations were set up for studying wheat, rice, corn, cotton, cane, vines, etc. There are now 8 in working order, and graphs are being made for each one's results. The whole work is carried out as in Russia, years ago, but Azzi's modern views are also considered throughout. The statistical method is being dealt with but we do not expect any appreciable result owing to lack of proper data. A 10-day bulletin is published in all the leading newspapers of the country setting out the conditions of the most important crops, pasture lands, rivers and roads, and how all of them were affected by the weather. Monthly abridged reports are published in magazines. Phenology as practiced in Canada and in England has been started with detailed sheets which are sent regularly every six months from many points of the country. None of these activities existed before June, 1921.

Rain and flood service.—All the rain data is being revised in view of the preparation of a special atlas which will be published this year. The atlas will contain normal deviation charts, normal and "reliability" charts, besides a general discussion of the different zonal dry and wet seasons.

A flood service for the Parahyba River was inaugurated, and the same work is under hand this year for the Amazon where the floods are very destructive to cattle caught unaware by the rising waters. Nothing of this was done by the old service.

Aerology.—Pilot-balloon observations are made at seven stations, including Rio. Two kite stations are being constructed, one in Alegrete (Rio Grande do Sul) and the other in Ceara. The first one will be inaugurated in a couple of months and should reveal interesting data of the secondary circulation in a region which we have denominated the turntable of moving "highs" and a frequent path of outgoing depressions. The Ceara station is expected to give us an explanation of the curious irregular droughts of northeastern Brazil, which to our mind can only be satisfactorily made clear by revealing unusual conditions of upper currents. Comparative climatology should show us later the origin of these unusual currents, and perhaps lead us to forecast their advent.

Aerology is also assisting aviation in Brazil, and we trust it will help the eminent meteorologists of the world in their search for the missing links of general dynamic theories of the atmosphere.

Aerological work in Brazil is beset with the enormous difficulty of rapid transportation. Hydrogen is only obtainable in Rio, so that pilot-balloon work in distant stations is impracticable until a cheap and convenient process of producing pure hydrogen locally is brought out.

No aerological work of any kind was done by the previous meteorological service.

In conclusion we may point out that meteorological activity in Brazil is surrounded by all kinds of difficulties. Brazil has a very refined and highly intellectual "elite"; but at the back of it exists an enormous mass of people with hardly any primary instruction. All cooperative work with volunteers is yet a dream. Any observer has to be paid and a very persistent action taken to instruct and train him conveniently. Another tremendous difficulty is the size of the country. One can imagine how and why this is so. Appropriations can not ever be sufficient. Considering Brazil is a new country with all kinds of financial and economical problems to solve, we can not expect Congress to exceed a certain budget, proportional to the capacities of the country, although small and modest from the point of view of the meteorologist who confined his thoughts to the development of his beloved science.

PRETECHNICAL METEOROLOGICAL STUDIES.[1]

By HOWARD E. SIMPSON.

[University of North Dakota, Grand Forks, N. Dak., December 20, 1922.]

A student contemplating meteorology as a profession has open before him three possible fields. These are (1) the United States Weather Bureau, (2) commercial meteorology, and (3) educational meteorology.

Commercial meteorology is as yet in a very undeveloped stage while educational meteorology, while occasionally given in a department of meteorology and climatology, is generally limited to courses offered in the departments of geology, geography, physics, or astronomy. There appears as yet no good reason for differentiating between the preparation for either of these or from that of the professional work of the Weather Bureau.

The United States Weather Bureau may be entered through civil service examination for (1) assistant observer, or (2) for observer and meteorologist. Only men are eligible for the latter examination.

For the position of assistant observer the examination is extremely elementary; little more than ordinary high-school subjects are required, the salary being insufficient to attract many college graduates.

The requirements include penmanship, English composition, arithmetic, algebra through quadratics, the geography of the United States, elementary physics and elementary meteorology. Meteorology is the only subject in the list not taught in the elementary public schools or standard high schools. A thorough study of Waldo's *Elementary Meteorology* is considered sufficient preparation for this elementary examination. Appointments to the Weather Bureau above the grade of messenger are made on the basis of an examination in these subjects.

By the more advanced examination it is desired to procure persons who both by education and experience are qualified for the broader work of the Weather Bureau. The examination for the position of observer and meteorogist have not been given for the last three or four years on account of funds not being available for making appointments at the higher salaries attached to these positions. It is hoped, however, that provision may early be made providing for regular promotion with increases of salary in the higher grades. This would enable the Weather Bureau to hold out more promising prospects to young men from the colleges and universities who may desire to follow meteorology as a profession.

The college subjects required for the higher examination are mathematics, including geometry, trigonometry, analytics, calculus, and the theory of statistics, physics,

[1] Read by title at Cambridge meeting of American Meteorological Society, Dec. 29, 1922.

astronomy, an English thesis, together with meteorology.

Applicants must show that they have had at least three years' training in a college or university of recognized standing and that such training included work in physics, mathematics, plant physiology or hydraulic engineering.

The thesis is limited to a subject in one of the following groups: (1) Physics, meteorology, hydraulics; (*b*) botany, plant physiology. It is also specified that special credit will be given under the heading of "training and experience" for special work on original investigation in meteorology, climatology, botany, hydraulic engineering, or physical laboratory work other than that required by the college course.

The observer's examination in meteorology is based primarily on standard college texts and while it is elementary and practical, is sufficiently comprehensive to require a mastery of the essentials of the subject.

The ideal pretechnical preparation for a meteorologist would be a complete four year college course in liberal arts leading to the degree of bachelor of arts or bachelor of science, with major work in physics and mathematics. A sound understanding of these two branches of learning is most essential but this should be supplemented by a broad knowledge of the natural sciences and such other courses in the liberal arts as will give breadth of mind and culture. The following list of subjects, while not intended to be rigidly followed, may be suggested as a guide to the student who is contemplating meteorology as a profession.

Subjects.	Semester hours.
Mathematics:	
Geometry, plain and solid in high school.	
College algebra	4
Trigonometry	4
Analytics	4
Calculus	8
Theory of statistics	4
	24
Physics:	
General physics	8
Mechanics	4
Heat	4
Light	4
Thermodynamics	2
Hydraulics	2
	24

Subjects.	Semester hours.
English:	
Rhetoric	6
English, correspondence	2
Engineering English	2
	10
General sciences:	
Astronomy, descriptive	4
Geology, physiography	4
Geography, human geography	4
Chemistry	8
Botany and plant phsiology	8
	28
Meteorology	4
Climatology	4
	8
Credit hours	94

There should be three years each of mathematics and physics and the latter should include the descriptive, laboratory, and experimental phase of the subject. Among the other sciences it is understood that these are all general courses except that the geology should include physiography and the geography should be geographic influences or human geography; and a half of the time in botany should be devoted to plant physiology.

The ability to read understandingly and to write a terse, accurate letter and a report in a precise, lucid style are highly essential to any scientist engaged in public service. A reading knowledge of both French and German is important, though one of these should be taken in the high school.

Of final importance and bearing most directly upon the professional work is meterology and climatology. One semester should be devoted to a good elementary course in meterology based upon Milham's *Meterology* or Moore's *Descriptive Meterology*, and a second semester to climatology with Ward's *Climate* or Hann's *Handbook of Climatology*, translated by Ward, as a text. While verging upon the technical, a second semester in Meterology using Humphreys' *Physics of the Air* as a basis is highly desirable though this may be left to be undertaken in the technical studies of the service after graduation. A suggested four-year course preparatory to technical meteorology follows:

	Elective.	Pre-meteor.	Total.
Freshman:			
English, rhetoric		6	
Physics, general		8	
Mathematics, algebra and trigonometry		8	
Foreign language (French or German)	6		
Electives	6		
	12	22	34
Sophomore:			
Physics		4	
Botany (general)		4	
Mathematics		8	
Science (chemistry)		8	
Foreign language (continued)	6		
Electives	4		
	10	24	34
Junior:			
Physics		4	
Botany (plant physiology)		4	
Mathematics		8	
Science (geology)		4	
Meterology and climatology		8	
English, correspondence		2	
Electives	4		
	4	30	34
Senior:			
Physics		8	
Science (astronomy)		4	
Science (geography)		4	
English, engineering		2	
Electives	16		
	16	18	34
	42	94	136

Practical observational work in connection with a meteorological station continuing throughout the upper years of the college course is of exceptional value to the student. It gives him a thorough appreciation of the relation of the several sciences to meteorology, assists him to assimilate the fundamentals, and cultivates his sense of observation. This can best be done by attaching oneself as voluntary observer or paid assistant to one of the several regular or special stations of the Weather Bureau located at institutions of higher learning.

Too great emphasis can not be placed on the sound judgment of Prof. W. M. Wilson, when he says concerning one contemplating a career in the Weather Bureau: "Aside from college training he would need adaptability, a liberal supply of good common sense, a willingness to begin at the bottom. I sometimes think that we stress the mind training to such a degree that we lose sight of these basic qualities upon which success is founded. The Weather Bureau can not use a young man, however highly trained, unless he has these qualities."

Acknowledgment is made to Prof. C. F. Talman, librarian of the United States Weather Bureau, and to my colleagues on the committee on meteorological instruction of the American Meteorological Society, Prof. Wilford M. Wilson, Cornell University; Willis I. Milham, Williams College; and Frank L. West, Utah Agricultural College, for helpful suggestions for this article. The author only, and not the committee, is responsible for all statements made.

DISCUSSION.

C. F. MARVIN, Chief, U. S. Weather Bureau.

The note by Professor Simpson is most timely and appropriate, with reference to opportunities of employment in meteorological lines of pursuit. The Chief of Bureau is pleased to encourage to the greatest possible degree the attainment of qualifications in meteorology for prospective service in the Weather Bureau. However, it does not seem amiss to say that under the schedules of the reclassification of Govenment employees the range of salaries is from $1,600 to maximums of $5,000 or $6,000, but it is quite obvious that the higher salaries go to a limited number of persons peculiarly qualified and occupied with difficult and specific lines of work. The greater number of employees of the Bureau are expected to perform extremely important duties in the administration of field work of the bureau concerned with forecasting, the conduct of stations in large and small cities, and the performance of a daily program of service to the public. Technical education, together with executive qualifications and keen business sense, are essential to the highest share of success.

It should not be supposed that employment in the Weather Bureau carries with it an assignment that represents only research work or investigation. However, notwithstanding this, the salary compensation for the effective performance of the immediate responsibilities at field stations, is attractive, and the tour of daily duties furnishes opportunities for those so qualified to engage in the pursuit of minor meteorological, climatological and forecasting researches whenever possible.

The foregoing comments are submitted with the belief that young men who are interested in the science and practical application of meteorology to human welfare will find a field of opportunity and prospect in the Weather Bureau that can hardly be surpassed elsewhere in congeniality and advantage.

VALUES OF THE SOLAR CONSTANT, 1920–1922.

By C. G. ABBOT and Colleagues.[1]

[Smithsonian Institution, Washington, D. C., March 29, 1923.]

INTRODUCTION.

Hitherto the Smithsonian Institution has promoted these researches on solar variation, as we may say, in faith. There were, to be sure, many fragmentary evidences, all pointing to the conclusion that the sun varies, and that its variations may be of importance for meteorology. But these variations are of so small a percentage range that it is only barely possible, by the most careful work in the most favorable climates, to make absolute determinations of the solar constant of radiation sufficiently accurate to reveal them. Evidences of solar variation collected in Volumes III and IV of the *Annals of the Astrophysical Observatory* seemed to have great probability. But the large expense, the sacrifice which the work cost, and the many years which we have devoted to it, combined to swell so heavy a debit account that no one of these individually hardly conclusive evidences, or even all of them together, could take away a load of deep anxiety. We could not help carrying in the back of our minds the misgiving lest this costly work should in the end prove wasted, except for the uninspiring result of proving a negative.

This is now past. We present the following results with confidence that they leave no reasonable doubt that the solar radiation varies, and that good work in well-established stations may be carried on with a continuously high-enough degree of accuracy to determine the variations. Confidence may now be assured that future observations at our two stations in the opposite hemispheres will accord even better than those made hitherto, and that they will disclose considerable variations of the sun. Arrangements are now completed to carry on these observations for several years.

This is our part. We think it will be an interesting and profitable task for meteorologists to examine what effects such solar variations produce on terrestrial weather conditions. Whether they will prove important forecasting evidences, the future will disclose.

THE NEW STATIONS.

Convinced of the unsuitability of Mount Wilson for a solar constant station to be occupied the entire year, inquiries were made through the United States Weather Bureau as to the most favorable station to be occupied in the United States. The desired qualities were (1) cloudlessness, (2) uniformity of sky, (3) high elevation above the surrounding country, (4) accessibility and habitability.

Professor Marvin, Chief of the United States Weather Bureau, very helpfully ordered a special research in connection with the matter. Two journeys were made by Mr. Edgar H. Fletcher, assistant observer at Phoenix, Ariz., to prospect for a suitable mountain location. He reported upon the following locations: Table Top Mountain and Montezumas Peak, near Maricopa, Ariz.; Black Peak, near Ajo, Ariz.; two peaks near Mohawk, Ariz.; the Chocolate Mountains, near Yuma, Calif.; San Jacinto Peak; the Calico Mountains, near Daggett, Calif.; Old Dads Mountain, near Bagdad, Calif.; Sugar-Loaf Peaks, near Barnwell, Calif.; Kessler Peak near Cima, Calif.; Crescent Peak near Crescent, Nev.; Mount Harqua Hala near Wenden, Ariz.

After consideration the stations Cima and Bagdad, Calif., and Wenden, Ariz., were selected as lying near accessible mountains which seemed most promising of those proposed. Chief Marvin caused daily observations of the amount and kinds of clouds, direction and velocity of the wind, and visibility of the mountains to be taken near Cima, Bagdad, and Wenden at the hours 7 and 9 a. m. noon and 3 and 5 p. m. These special observations were commenced in December, 1919, and continued until December, 1920. By June, 1920, it seemed clear that, on the whole, the station on Mount Harqua Hala, near Wenden, Ariz., had proved most advantageous of the mountain stations considered, and the Smithsonian Institution ordered the construction there of a suitable observing shelter. The original building, comprising two

[1] My colleagues, F. E. Fowle, L. B. Aldrich, A. F. Moore, L. H. Abbot, and J. A Roebling, have each and all contributed so largely in different ways to these results that their names are entitled to coauthorship. It is only to avoid cumbrous citations that they are omitted in the heading.

Only less valuable and indispensable for the research has been the conscientious painstaking, and enthusiastic work of Messrs. A. Kramer, P. E. Greeley, F. A. Greeley Mrs. G. M. Bond, and Miss M. A. Neill.

We owe, besides, much to the help of the Weather Bureaus of the United States, Chile, and Argentina, the Chile Exploration Co., and to many citizens of Wenden Ariz., especially Mr. W. B. Ellison and Mr. J. E. Matteson.

stories, one below ground, the other above ground, is shown in Figure 1.

We published a summary of solar-constant values up to August, 1920, in Volume IV of the *Annals of the Astrophysical Observatory*. These included values from Mount Wilson, Calif., Hump Mountain, N. C., and Calama, Chile. In September, 1920, the solar-constant apparatus which had been for 15 years on Mount Wilson was removed to a new station on Mount Harqua Hala, Ariz., and in August, 1920, the apparatus which had been for two years at Calama was removed to a new station at Montezuma, Chile. The stations were both erected with funds supplied by Mr. John A. Roebling, who initiated the removal idea.

An account of the Montezuma station was published in the MONTHLY WEATHER REVIEW for December, 1921. Values observed there have been published at somewhat irregular intervals in the same journal. Hitherto nothing has been published from Mount Harqua Hala, although nearly 500 days of observation have occurred there. We have now completed the discussion of these results as far as September 20, 1922. At that date improved apparatus was substituted and the bolographic spectrum definition brought up to be equal to that at Montezuma. Beginning January 1, 1923, a revision of the computing data used at Montezuma was introduced so as to bring every detail of the work at the two places into accord. Hence, from January, 1923, we expect to find the results of the two stations in closer agreement than ever hitherto, but before publishing we shall withhold them for several months so as to redetermine the systematic errors which may have altered with these changes.

The present publication is an account of the selection and construction of Mount Harqua Hala station, a discussion of the systematic errors of its observations, and a summary of the results of both stations up to September 20, 1922, when the change was made in the apparatus at Harqua Hala.

In order to show the degree of cloudlessness of Wenden, as compared with other stations in the Southwest, we give here a table of values kindly furnished by Dr. H. H. Kimball from records of the Weather Bureau. It will be seen that for 12 months there were almost two-thirds of the days at Wenden when the sky did not exceed 10 per cent cloudy in the morning hours. Another feature which was regarded as favorable was the prevalence of dwarfed vegetation in the desert and upon Mount Harqua Hala. This would tend to keep down dust. The altitude of Mount Harqua Hala above sea level is 5,680 feet, and above the surrounding country, which lies about 2,000 feet above sea level, it is 3,700 feet. These values exceeded those of other mountains proposed. This also favors a clear sky as regards dust.

Readers should not lose sight of the fact that though the stations Yuma and Needles, Calif., show somewhat less cloudiness than Wenden, we were concerned to find isolated but accessible and habitable mountains of considerable height above the plain, so as to avoid surface dust. Such mountains were not available near Yuma and Needles.

TABLE 1.—*Number of days with cloudless sky.*

Station.	Time.	1920											1919	
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Cima, Calif.	7 a. m.	9	6	9	13	21	22	17	18	18	13	15	9	170
Bagdad, Calif.	...do....	4	7	11	14	22	19	11	14	19	10	12	9	152
Wenden, Ariz.	...do....	8	6	17	18	25	20	19	17	18	11	16	11	186
Independence	5 a. m.	14	16	16	14	17	15	18	18	23	21	17	16	205
Needles, Calif.	...do....	26	22	24	27	28	24	26	21	24	23	27	29	301
Flagstaff, Ariz.	...do....	17	13	15	12	18	17	14	15	14	13	22	20	190
Phoenix, Ariz.	...do....	15	8	16	13	17	15	6	6	13	13	19	22	163
Yuma, Ariz.	...do....	22	17	19	25	27	25	20	18	22	25	29	23	272
Cima	9 a. m.	7	6	10	11	20	19	12	13	13	11	14	10	146
Bagdad	...do....	4	6	12	13	17	16	12	14	15	11	10	10	140
Wenden	...do....	6	6	13	19	24	19	17	17	18	13	16	11	179
Cima	Noon	8	5	8	12	18	15	12	7	13	9	14	7	128
Bagdad	...do....	4	4	10	9	15	16	10	9	16	12	5	6	116
Wenden	...do....	6	6	14	18	22	17	12	13	17	15	14	14	168
Independence	...do....	6	6	9	7	9	9	9	12	10	13	7	13	110
Phoenix	...do....	3	1	8	8	14	13	7	9	13	9	12	12	109
Yuma	...do....	8	7	18	25	25	24	18	17	20	22	19	14	217
Cima	3 p. m.	4	3	7	9	16	13	8	7	14	10	12	8	111
Bagdad	...do....	5	4	10	5	15	14	11	6	16	11	7	6	110
Wenden	...do....	6	5	15	20	21	20	13	8	17	18	16	14	173
Cima	5 p. m.	5	4	6	9	14	16	11	8	16	11	13	8	121
Bagdad	...do....	6	5	8	11	14	12	10	8	15	10	7	8	114
Wenden	...do....	8	9	13	20	21	24	15	9	23	18	23	14	197
Independence	...do....	7	7	7	7	6	5	9	5	6	12	7	11	89
Needles	...do....	11	9	15	17	18	20	20	22	22	16	17	20	207
Flagstaff	...do....	5	5	7	7	9	9	6	6	10	12	15	11	102
Phoenix	...do....	3	2	10	13	16	14	8	5	9	11	13	10	114
Yuma	...do....	5	4	17	19	21	23	15	16	17	17	19	14	187
Cima	Day	3	2	4	4	14	10	8	6	10	8	8	6	83
Bagdad	...do....	3	1	5	4	10	9	6	6	10	9	4	6	73
Wenden	...do....	3	5	8	15	19	17	10	7	13	10	12	9	128
Independence	...do....	4	4	4	3	4	4	5	4	3	8	6	9	58
Phoenix	...do....	3	0	6	4	12	9	4	4	5	6	8	10	71
Yuma	...do....	3	3	11	18	20	20	14	10	12	15	15	11	152
		1918												
Independence	Day	8	5	6	6	0	3	4	5	5	6	5	5	58
Phoenix	...do....	2	3	4	4	8	1	0	2	6	4	6	5	45
Yuma	...do....	13	12	8	16	14	7	8	7	12	12	13	15	137

TABLE 2.—*Number of days on which the cloudiness did not exceed 10 per cent.*

Station.	Time.	1920											1919	
		January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
Cima	7 a. m.	12	9	15	19	24	25	19	21	21	21	21	13	220
Bagdad	...do....	4	8	17	20	23	22	15	14	20	12	12	....	167
Wenden	...do....	11	7	22	22	29	23	25	20	22	14	20	17	232
Independence	5 a. m.	22	20	21	21	26	23	23	28	25	26	20	25	280
Needles	...do....	26	22	24	27	28	24	26	21	24	23	27	29	301
Flagstaff	...do....	18	15	17	19	22	22	21	20	20	14	22	20	230
Phoenix	...do....	16	12	20	22	29	22	22	21	27	19	23	23	256
Yuma	...do....	27	18	25	26	29	28	24	23	25	28	29	27	309
Cima	9 a. m.	9	7	13	19	20	21	17	16	17	14	19	15	187
Bagdad	...do....	4	10	16	19	19	17	13	14	17	12	10	....	151
Wenden	...do....	8	7	17	19	26	20	21	21	23	18	17	16	213
Cima	Noon	9	6	11	15	18	19	13	11	17	12	17	16	164
Bagdad	...do....	4	7	12	18	17	16	11	11	20	14	7	....	137
Wenden	...do....	7	9	17	20	22	22	17	20	23	17	16	15	205
Independence	...do....	13	16	14	23	19	15	23	23	21	20	12	19	218
Phoenix	...do....	10	9	18	21	24	20	25	26	25	15	16	21	230
Yuma	...do....	15	14	24	28	27	28	27	24	26	27	26	23	289
Cima	3 p. m.	5	4	9	14	17	16	11	8	17	11	16	14	142
Bagdad	...do....	6	5	13	15	16	18	12	8	18	14	18	....	143
Wenden	...do....	6	8	17	20	22	22	18	12	20	19	19	15	198
Cima	5 p. m.	9	4	10	16	17	20	14	11	19	14	19	16	169
Bagdad	...do....	8	5	12	15	16	13	10	11	16	12	7	....	125
Wenden	...do....	9	10	15	21	22	26	16	13	24	20	24	19	219
Independence	...do....	12	10	16	15	17	15	20	17	19	19	11	17	188
Needles	...do....	11	9	15	18	19	21	20	23	22	16	19	20	213

FIG. 1.—Smithsonian Observatory, Mount Harqua Hala, Ariz. Original condition.

FIG. 2.—Smithsonian Observatory, Mount Harqua Hala, Ariz. Condition in 1922.

FIG. 3.—Wenden, Ariz., Mount Harqua Hala in distance.

FIG. 4.—Instruments, Mount Harqua Hala, Ariz. F. A. Greeley observing with pyrheliometer.

FIG. 5.—Observatory at Montezuma, Chile. (Cave near mountain summit.)

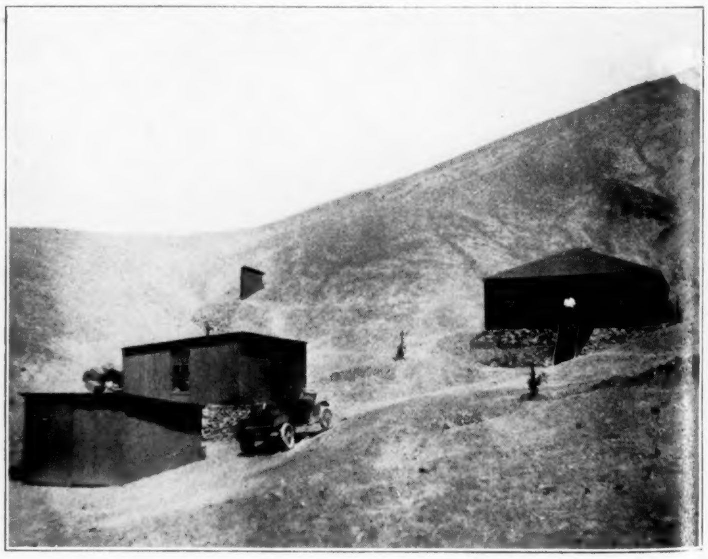


FIG. 6.—Dwelling at Montezuma, Chile.

TABLE 2.—*Number of days on which the cloudiness did not exceed 10 per cent*—Continued.

Station.	Time.	January.	February.	March.	April.	May.	June.	July.	August.	September.	October.	November.	December.	Year.
		1920											1919	
Flagstaff	5 p. m.	8	7	8	13	13	16	12	10	15	14	17	13	146
Phoenix	...do....	9	8	13	16	20	19	12	10	18	15	19	18	177
Yuma	...do....	15	13	27	25	28	26	23	23	23	26	23	23	275
Cima	Day....	4	3	8	10	16	12	10	6	14	9	12	7	111
Bagdad	...do....	4	4	8	9	11	11	7	6	11	10	5	....	86
Wenden	...do....	3	5	10	19	20	19	12	8	17	12	14	10	149
Independence	...do....	9	9	9	12	12	13	14	17	15	13	9	14	146
Phoenix	...do....	6	4	10	13	19	17	11	10	17	12	14	15	148
Yuma	...do....	14	10	20	23	25	24	21	16	21	23	21	21	239
		1918												
Independence	Day....	19	10	15	14	6	13	15	18	12	11	11	10	154
Phoenix	...do....	14	12	10	14	13	11	6	8	16	17	13	15	149
Yuma	...do....	17	15	10	21	19	20	13	10	16	18	19	22	200

In consequence of the rapid rise and abrupt approaches to the summit of Mount Harqua Hala, there are no means of access except a steep and narrow trail, difficult to use for packing parcels of large size or weight. On this account it seemed best to construct the building (40 by 10 feet) of adobe bricks, which were made on the summit, with sand, mud, and water, all collected within a mile of the building. The walls are 12 inches thick. The lower rooms for the instruments are almost entirely below the level of the ground except at the southern end, and here the dirt and stones removed at the other end were heaped up against the walls so as practically to make all but the southern wall of the lower story under ground. This, of course, is highly favorable to a constant temperature for the instruments.

The station on Mount Harqua Hala was first occupied by Messrs. C. G. Abbot and L. B. Aldrich about September 25, 1920. Observations were begun there on October 3, 1920. Since then the observations have been carried on as follows:

Date.	Observer.
October 3, 1920–January 21, 1921	C. G. Abbot. F. A. Greeley.
January 21–April 22, 1921	L. B. Aldrich. F. A. Greeley.
April 22, 1921–Present	A. F. Moore. F. A. Greeley.

During Mr. Moore's administration, Mrs. Moore not only has assisted occasionally in computations, but has always cooperated with enthusiasm for the morale of the station as well as attending to the household work and keeping the place attractive and homelike.

Many improvements have been made through the kindness of Mr. John A. Roebling. Heavy rains washed away part of the adobe walls, so that on Mrs. Moore's suggestion, they were sheathed with sheet metal. A small shop was erected. Water tanks of cement, having a total storage of 2,000 gallons, were built by Moore and Greeley and connected to the roofs to catch the rain and snow water. An ingenious shower bath, of Mr. Moore's design, makes summer heat more tolerable. A sulphur-dioxide refrigerating plant called the "Kelvinator" aids to keep food, and make it palatable. Wireless telephone devices enable the staff to "listen in" as far east as Schenectady on favorable occasions. A wire telephone to Wenden is of the very greatest use. At the foot of the mountain trail is a small garage to keep the Ford automobile used to transport supplies over the 11 miles to and from Wenden. Mr. Ellison, a mining prospector, has been an exceptionally kind neighbor, and makes regular trips to Wenden for mail and supplies.

THE SOLAR OBSERVATIONS.

After making many days of "long method" observations to determine the relations of atmospheric transmission to values of the "Function" (which is found by dividing the pyranometer measurement of sky radiation near the sun by the value $\rho/\rho_{s.c.}$ as explained in our account of Chilean observations) "Function transmission curves" were plotted for Harqua Hala.[2] The air masses chosen for these curves were 1.3, 2, and 2.7. As was the case at Calama and Montezuma, it was impossible to determine these curves satisfactorily at high values of the "Function," such as attend the most humid days of summer. For at such times the atmosphere almost never remains uniformly transparent long enough to determine its transmission coefficients by the "long method." Accordingly, we expected that systematic errors would be found to be associated with the work, depending on the values of the "Function" or on the values of "precipitable water" in the atmosphere. For this reason we withheld the Harqua Hala work from publication for two years, until so large a mass of data accumulated that it could be treated statistically to determine and correct these systematic errors.

It proved best to determine the errors primarily as functions of "precipitable water." But when this was done, slight additional corrections were found desirable at very large and very small values of the "Function." Our procedure has been first to group all the solar constant values at each of the three air masses, 1.3, 2, 2.7, separately, between limits of "precipitable water" as determined from the bolographs by Fowle's method.[3] It seemed desirable to eliminate changes depending on the monthly march of the solar constant before taking means of these groups. Having already found by similar studies that no sensible corrections are needed at Montezuma, we took the monthly mean values derived at Montezuma[4] as indicative of the march of the solar constant. They are as follows:

TABLE 3.—*Corrections to constant sun.*

	1920			1921			
	October.	November.	December.	January.	February.	March.	April.
Number of days	20	24	20	9	7	12	16
Mean value	1.945	1.948	1.957	1.955	1.956	1.949	1.944
Correction to 1.950	+.005	+.002	−.007	−.005	−.006	+.001	+.006

	1921							
	May.	June.	July.	August.	September.	October.	November.	December.
Number of days	12	17	17	....	5	13	15	12
Mean value	1.946	1.939	1.947	....	1.953	1.956	1.947	1.952
Correction to 1.950	+.004	+.011	+.003	0.000	−.003	−.006	+.003	−.002

[2] See Annals Astrophysical Observatory, Vol. IV, figs. 6 and 7.
[3] See Annals, Astrophysical Observatory, Vol. III, p. 171.
[4] These values differ slightly from those given in Table 5 on account of including some days omitted in that table and also smoothing some months.

TABLE 3.—*Corrections to constant sun*—Continued.

	1922							
	January.	February.	March.	April.	May.	June.	July.	August.
Number of days	19	11	16	13	4	11	8	10
Mean value	1.944	1.950	1.938	1.931	1.925	1.911	1.911	1.918
Correction to 1.950.	+.006	.000	+.012	+.019	+.025	+.039	+.039	+.032

From these data we felt that we could approximately eliminate from our Harqua Hala groups long continued departures of the solar constant by altering each individual value by the appropriate amount given in the last line of the preceding table. Thus all values for January, 1921, were decreased by 0.005, while those for July, 1921, were increased by 0.003, etc. This correction designed to eliminate the general march of solar variation having been made, the mean values of the solar constant corresponding to each group were found and plotted against mean precipitable water for the same group. Thus were determined the corrections to be applied to reduce solar constant values to a uniform amount of precipitable water. The results were quite definite in trend and on the whole satisfactory.

However it was noticed that within each group there was a considerable range of "Function" values. Hence, the data in each "precipitable-water" group were regrouped with reference to the value of the "Function" which prevailed. Upon examination of the plots resulting, it appeared that certain small additional corrections, never reaching so much as 1 per cent, and seldom as much as one-half per cent, should be applied to eliminate residual errors depending on the "Functions," and not fully removed by the first process.

Having in these ways found the best values of the corrections necessary to remove the influences of water vapor and "Function" value on solar constant work at Harqua Hala, one further systematic correction was required. The Harqua Hala observations proved to be on the whole a little smaller than those made at Montezuma. In order to obtain a homogeneous system so that values which were observed alone at Harqua Hala, or alone at Montezuma, would be comparable with those observed at the other station, or with mean values from both, a small horizontal increase was made in the Harqua Hala values to bring them up to the scale of Montezuma. This was a little over 1 per cent.

We now returned to the original observations at Harqua Hala (not modified to allow for solar changes), and taking into account the air mass, the "precipitable water," and the "Function" prevailing, we applied to each value independently the corrections statistically determined, as above described, from the discussion of them all. Readers will note that these corrections do not depend on Montezuma work except in two ways. First, the apparent monthly march of the solar constant has been eliminated from the water-vapor corrections at Harqua Hala by considering Montezuma monthly mean values. Second, a slight horizontal increase of all Harqua Hala observations has been made to bring about an homogeneous final scale of values. Obviously neither of these modifications can have brought to bear any influence from Montezuma on the *variability* of the sun as determined at Harqua Hala.

The following tables give, besides the individual results at both stations, their weighted means, and the final weighted mean. In weighting, we have considered the observers' notes as to the sky conditions prevailing, the number of observations, their agreement, the air mass (giving large air masses half weight), and have omitted from final means, or given small weight, the determinations which were unsatisfactory at one of the stations. The grades given mean "satisfactory," "less satisfactory," and "unsatisfactory."

We have made no use of "long method" values at Harqua Hala, except for determining "Function transmission curves." We consider them individually so much less accurate than "short-method" values, because they are influenced by clearing up or hazing up of the atmosphere, while short method values are not, that to include them in the mean values would injure the work. The observers at Montezuma have been accustomed to give "long method" values half weight. We have thought it best not to alter their "weighted mean" values already published in the MONTHLY WEATHER REVIEW, but have modified the grade assigned.

In a preliminary Table 7 we give values for Montezuma observed in August and September, 1920. The columns are identical in character with columns 1 and 7 to 12 of the main table described below.

The main Table 8 contains 15 columns. First, date; second, third, and fourth are the decimal parts of Harqua Hala solar-constant values derived by the short method from observations nearest 1.3, 2, and 2.7 air masses, respectively; fifth, gives the weighted mean of these, and sixth its grade. Columns 7, 8, 9, and 10 are similar Montezuma values, nearest the air masses 1.5, 2, 2.5, and 3, which were adopted in drawing the "Function transmission curves" there. Column 11 gives long-method values at Montezuma. Column 12 gives the weighted mean of Montezuma values, and column 13 its grade. Column 14 gives the finally adopted solar constant value for the day and column 15 its grade.

In cases where more than one observation was made near one of the standard air masses only the mean value of them is given. A small figure, like an exponent, indicates for this mean value how many observations it represents.

We have been particularly interested to ascertain how closely the observations of the two stations duplicate each other. We have, as said above, applied a small horizontal increase at Harqua Hala to bring the two series to the same scale. We hope that it will prove that the magnitude of this, and of the corrections depending on humidity, will be reduced, now that the work has been brought to an identical basis at the two stations. A comparison of values, however, will show the magnitudes of the accidental experimental and local atmospheric errors in the work of 1920 to 1922. In making such a comparison, we have felt justified in rejecting all days marked unsatisfactory at either station. Those rejected include a number of days of January, February, and March, 1922, when an accident to the pyranometer at Montezuma threw back the daily work there to single long-method determinations. There remain in common observations distributed as shown in the following table, which gives differences H. H.—Montezuma.

TABLE 4.—*Mean differences (H. H.—Montezuma).*

	1920.			1921.				
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May.
Number of plus	3	6½	2	3	2	1½	4	3
Number of minus	3	3½	1	0	2	1½	2	1
Mean of plus	0.0083	0.0126	0.0055	0.0367	0.0200	0.0040	0.0097	0.0123
Mean of minus	.0063	.0200	.0110	....	.0080	.0247	.0135	.0080
General mean	.0073	.0153	.0073	.0367	.0130	.0143	.0110	.0112

	1921.						
	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Number of plus	6	0	1	1	3	4	2
Number of minus	8	2	0	2	3	2	5
Mean of plus	0.0107	....	0.0030	0.0050	0.0143	0.0139	0.0060
Mean of minus	.0122	0.0050	....	.0260	.0087	.0090	.0172
General mean	.0116	.0050	.0030	.0190	.0115	.0122	.0140

	1922.								Total.
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	
Number of plus	6	1	2	2	1	6	2	1½	63½
Number of minus	4	0	1	2	1	3	3	1½	51½
Mean of plus	0.0085	0.0170	0.0175	0.0180	0.0090	0.0183	0.0100	0.0127	0.0137
Mean of minus	.0175	....	.0060	.0230	.0010	.0030	.0197	.0087	.0124
General mean	.0126	.0170	.0137	.0205	.0050	.0132	.0158	.0107	.0132

According to this summary, the numbers and averages of plus and minus deviations are nearly equal. There is no certainly discernible monthly march tending to alter the prevailing sign of difference during the year, notwithstanding that the two stations are on opposite sides of the Equator. The mean difference, without regard to sign, is approximately 0.68 per cent of the solar constant. Dividing this by $\sqrt{2}$ and multiplying the quotient by 0.84, the probable accidental error of a single good day's determination at one station comes out approximately 0.41 per cent. We consider this satisfactory, but we hope it will be found that the new work to follow January, 1923, will give a still closer accord between the two stations.

As the purpose of the work is primarily to reveal, confirm, and evaluate variations of the solar constant, we must look with highest interest on a comparison designed to indicate if the two stations agree in pointing out intervals of the high and low values. The observations are so broken, especially in Chile, that consecutive plotting is an unsatisfactory means of comparison. However, we may point out the periods 1920, November 1 to 18; 1921, January 8 to 16, February 11 to March 4, April 1 to 17, November 17 to December 10; 1922, January 15 to 19, February 12 to 22, as prevailingly high, and the periods 1921, June 4 to 13, October 8 to 22;

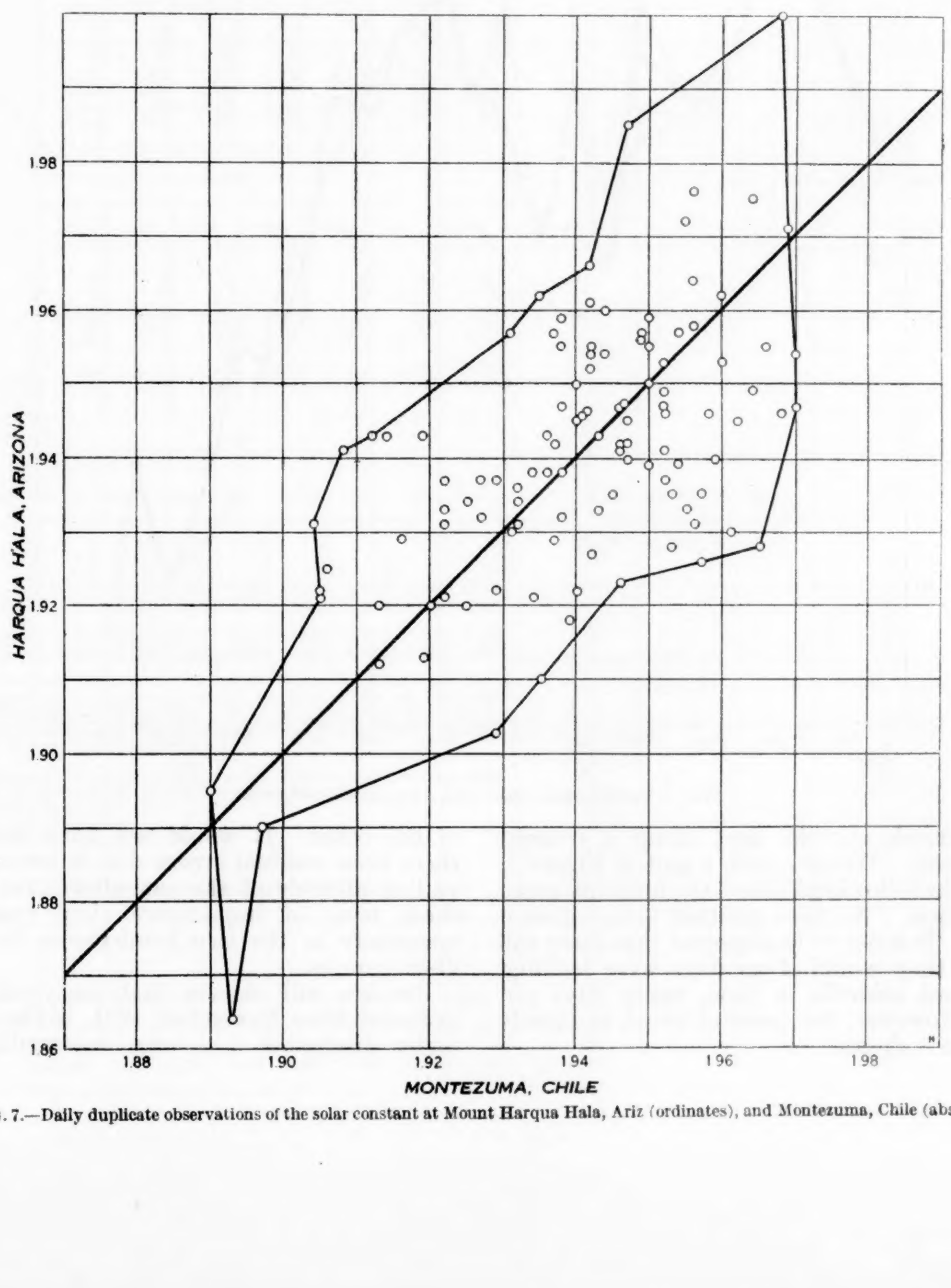


FIG. 7.—Daily duplicate observations of the solar constant at Mount Harqua Hala, Ariz (ordinates), and Montezuma, Chile (abscissæ).

1922, January 4 to 12 and March 1 to the end of our period in September, as prevailingly low at both stations.

A more satisfactory method of comparison, in view of the broken character of the data, consists in plotting the duplicate daily observations at the two stations as abscissæ and ordinates, respectively. In such a plot real solar variations stretch out the data along a straight line at 45° inclination. We give such a plot in Figure 7.

We also give in the following Table 5 the monthly mean values at each station. We have omitted values graded "Unsatisfactory." It is not to be expected that these will accord as well as they would if no days were lacking, because they do not coincide in time, many days not being common. However, the general trend is closely the same, as Figure 8 shows.

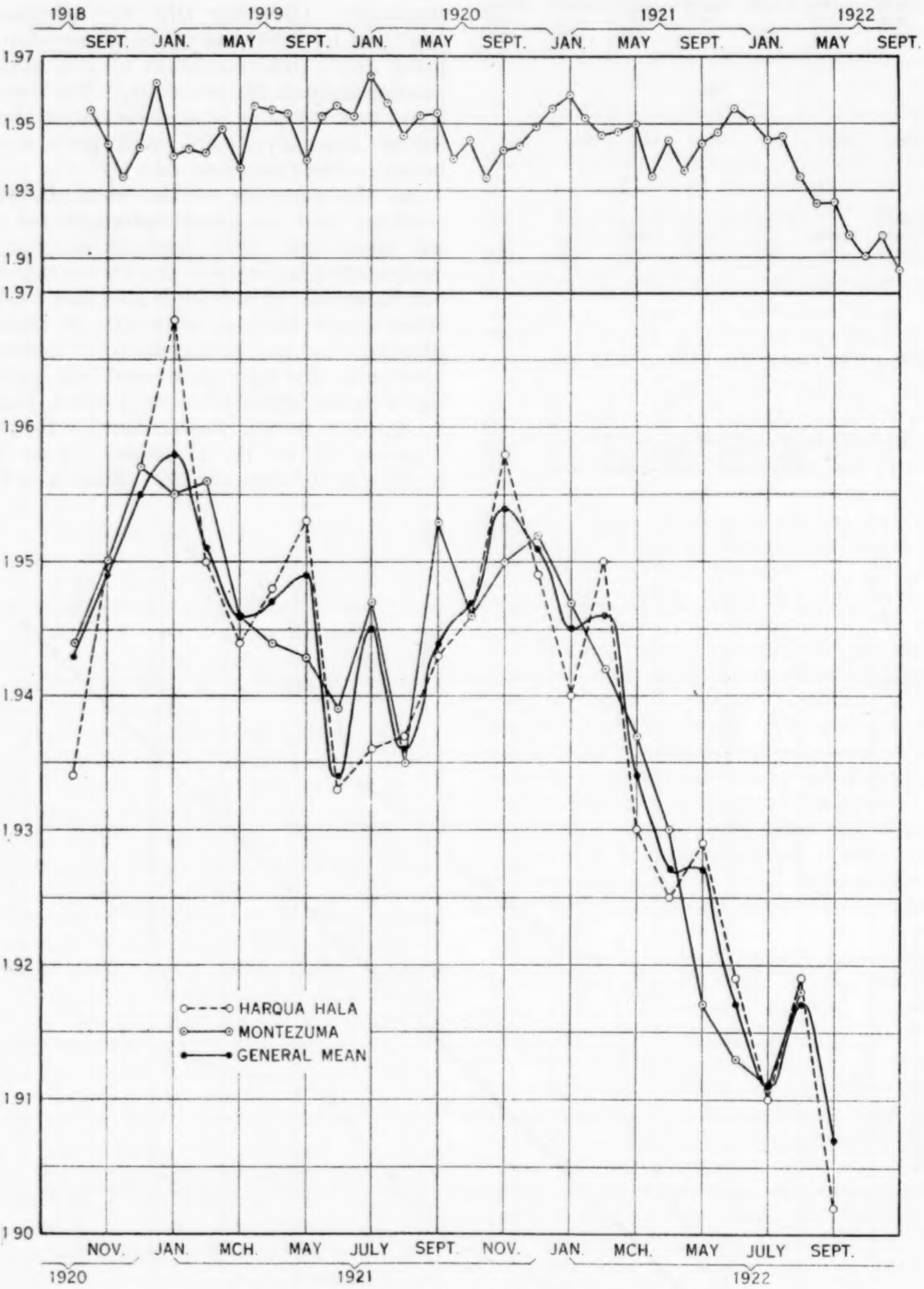


FIG. 8.—Monthly mean values of the solar constant compared.

The average monthly mean difference, H. H.—Montezuma, is about 0.3 per cent. It is very reassuring not to perceive in the plots a definite tendency to separation at particular parts of the year, such as would indicate a yearly periodicity due to erroneous observations. For it should be recalled that summer of one station is winter of the other. It would not have been surprising had there been residual errors due to temperature or to prevailing altitude of the sun above the horizon, and had these been of importance they would have worked oppositely in the two hemispheres to produce notable discrepancies.

Readers will observe that the rapid fall of the solar radiation from November, 1921, to the close of the period under discussion is a very outstanding feature of the

results. In order to show how very unusual and remarkable this is, we give in a small-scale plot at the top of the figure the curve of monthly mean values from August, 1918, when the Chilean station was established, to September, 1922, the close of the comparison we are making. The Calama values are given in Table 6. It is apparent that in these four years there has never been any solar change so marked and extraordinary as the one just mentioned, nor have our observations at Mount Wilson indicated a parallel to it, with the possible exception of 1913. This statement, however, is subject to the qualification that the Mount Wilson values never covered more than half of the year, and frequently less.

Unpublished observations at Arizona and Chile since September, 1922, indicate that the low solar values continued and perhaps became still more pronounced. Whether this has an important bearing on the unusual weather conditions of recent months will be for meteorologists to decide.

TABLE 5.—*Monthly mean values compared.*

["Unsatisfactory" values omitted, U+ retained.]

	1920			1921			
	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.
No., Harqua Hala	11	10	3	9	17	9	15
No., Montezuma	20	25	21	9	7	13	16
No., in mean	25	25	22	14	20	18	26
Mean, Harqua Hala	1.934	1.950	1.957	1.968	1.950	1.944	1.948
Mean, Montezuma	1.944	1.950	1.957	1.955	1.956	1.946	1.944
Harqua Hala-Montezuma	0.010	0.000	0.000	0.013	−0.006	−0.002	0.004
General mean	1.943	1.949	1.955	1.958	1.951	1.946	1.947

	1921							
	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
No., Harqua Hala	13	20	5	12	25	19	17	10
No., Montezuma	12	17	17	1	5	11	14	12
No., in mean	22	23	21	11	27	23	24	15
Mean, Harqua Hala	1.953	1.933	1.936	1.937	1.943	1.946	1.958	1.949
Mean, Montezuma	1.943	1.939	1.947	1.935	1.953	1.946	1.950	1.952
Harqua Hala-Montezuma	0.010	−0.004	−0.011	0.002	−0.010	0.000	0.008	−0.003
General mean	1.949	1.934	1.945	1.936	1.944	1.947	1.954	1.951

	1922								
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.[1]
No., Harqua Hala	13	8	12	17	20	23	18	9	13
No., Montezuma	18	9	11	11	5	10	8	10	2
No., in mean	21	16	20	24	24	24	19	15	13
Mean, Harqua Hala	1.940	1.950	1.930	1.925	1.929	1.919	1.910	1.919	1.902
Mean, Montezuma	1.947	1.942	1.937	1.930	1.917	1.913	1.911	1.918	1.930
Harqua Hala-Montezuma	−0.007	0.008	−0.007	−0.005	0.012	0.006	−0.001	0.001	−0.028
General mean	1.945	1.946	1.934	1.927	1.927	1.917	1.911	1.917	1.907

[1] This month is incomplete. A change in apparatus was made at Harqua Hala after Sept. 20, so that the table closes with that day. Only two satisfactory observations being reported from Montezuma, and these quite out of the general trend, the large difference between the stations should be discounted.

Average monthly deviation (Harqua Hala-Montezuma) without regard to sign, 0.0057, or 0.3 per cent. Range of solar variation in monthly means 2.5 per cent.

General means (Montezuma alone):
August, 1920, No. 27, value, 1.934.
September, 1920, No. 25, value, 1.942.

TABLE 6.—*Monthly mean values at Calama, Chile.*

	1918					1919		
	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.
Number of observations	27	18	24	23	19	19	20	16
Mean value	1.954	1.944	1.934	1.943	1.962	1.940	1.942	1.941

TABLE 6.—*Monthly mean values at Calama, Chile*—Continued.

	1919								
	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Number of observations	27	27	22	27	30	28	20	25	24
Mean value	1.948	1.937	1.955	1.954	1.953	1.939	1.952	1.953	1.952

	1920						
	Jan.	Feb.	Mar.	Apr.	May.	June.	July.
Number of observations	25	19	29	30	29	23	21
Mean value	1.964	1.956	1.946	1.952	1.953	1.939	1.945

We reserve further comment on the results. We hope they will prove valuable to meteorologists. As we have intimated already, the present outlook warrants the hope that more numerous and more concordant observations will be available from January 1, 1923. Arrangements have been made to continue daily observations at both stations until July, 1925, when it will be earnestly considered whether they should continue longer, and if so, under what auspices.

TABLE 7.—*Montezuma values, August–September, 1920.*

Date.	Solar constant.						
	1.5	2.0	2.5	3.0	Long.	Mean.	Grade.
1920.							
Aug. 1							
2							
3					919	1.919	S
4					922	1.922	S
5					927	1.927	S
6		962				1.962	S−
7					932	1.932	S+
8		919	926			1.922	S−
9		944	939	928		1.937	S
10		933	915			1.922	S−
11		923	924	927		1.925	S
12					932	1.932	S+
13					979	1.979	S+
14		921				1.921	S−
15			915	926		1.920	S−
16							
17					968	1.968	S+
18			943	942		1.943	S−
19		942	932	946		1.940	S
20					924	1.924	S
21					940	1.940	S
22		939	951			1.945	S
23					942	1.942	S+
24		897	905			1.901	S−
25							
26	949	939				1.945	S
27					928	1.928	S+
28					951	1.951	S+
29					915	1.915	S
30					921	1.921	S
31					923	1.923	S
Sept. 1					939	1.939	S+
2					956	1.956	S
3	957	947				1.952	S
4							
5		954	927			1.936	U+
6	870	867	875	897	901	1.885	S−
7					951	1.951	S
8					964	1.964	S
9	943		942	950	918	1.945	S+
10					953	1.953	S
11		926	926			1.926	S
12					943	1.943	S+
13		949	927	949	916	1.940	S
14					945	1.945	S+
15			950	969		1.961	S−
16					937	1.937	S
17					951	1.951	S+
18					948	1.948	S
19	[2] 932					1.932	S
20							
21							
22	947	936	935			1.937	S
23					961	1.961	S
24					946	1.946	S
25					941	1.941	S
26		944	934	938		1.939	S
27					914	1.914	S−
28					952	1.952	S
29							
30							

TABLE 8.—*Harqua Hala and Montezuma values, October, 1920, to September 20, 1922.*

		H. H. solar constant.					Montezuma solar constant.							Weighted mean.	Grade.
		1.3	2.0	2.7	Mean.	Grade.	1.5	2.0	2.5	3.0	Long.	Mean.	Grade.		
1920.															
Oct.	1										938	938	S	1.938	S
	2							928	930	933	912	928	S	1.928	S
	3														
	4	944	941		942	S					946	946	S	1.944	S
	5	[2]981			981	U					951	951	S−	1.951	S−
	6							931	928	918	937	929	S	1.929	S
	7								908	925		917	S−	1.917	S−
	8	958	946		952	S	[2]942					942	S−	1.947	S
	9						964	957				959	S	1.959	S
	10	896	975		935	U	[2]947					947	S−	1.947	S−
	11							956	957	959	948	956	S	1.956	S
	12			980	980	U		940	929	954		943	S−	1.943	S−
	13		902	880	891	U								1.891	U
	14	936	957	958	949	S								1.949	S
	15	959	980	979	971	S					969	969	S	1.970	S
	16	936	960	945	947	S					952	952	S	1.950	S
	17							933	944	950		944	S−	1.944	S−
	18	951	960		955	S−		943	939	943		942	S−	1.948	S−
	19														
	20														
	21			971	971	U		940	948	955	954	951	S−	1.951	S−
	22	937	939	923	935	S	[2]945					945	S	1.940	S
	23	[2]933			933	S								1.933	S
	24	914	918	856	916	S−								1.916	S−
	25	902	928	911	914	S	954					954	U	1.934	S−
	26	946	964	958	955	S								1.955	S
	27														
	28							[2]941	943			942	S−	1.942	S−
	29										948	948	S−	1.948	S−
	30						[2]931					931	S−	1.931	S−
	31														
Nov.	1										963	963	S	1.963	S
	2	935	933	919	931	S	953	958				956	S	1.943	S
	3	973	982	973	976	S		960	951			956	S	1.966	S
	4								938	957		952	S−	1.952	S−
	5		963		963	U	951	936	946		974	950	S	1.954	S
	6						955	950	940			948	S	1.948	S
	7							952	941			945	S−	1.945	S−
	8	949	960	957	955	S		949	951			950	S	1.952	S
	9						944	947	948			947	S	1.947	S
	10	949	958	968	956	S−	940	[2]953				949	S−	1.952	S
	11						952	[2]956				955	S	1.955	S
	12								944	928		938	S−	1.938	S−
	13		953	944	950	S	952	949		950	950	950	S+	1.950	S+
	14		[2]966		966	S−	[2]942					942	S	1.953	S
	15										964	964	S	1.964	S
	16		940	924	934	S−		929	918			925	S−	1.929	S
	17		[2]949		949	S−	[2]964					964	S−	1.956	S
	18	941	981		961	S−		936	941	947		942	S	1.951	S−
	19														
	20		999		999	U								1.999	U
	21			926	926	S−	957					957	S−	1.941	S−
	22						953	928				945	S−	1.945	S
	23						[2]956					956	S	1.956	S
	24								931	937		935	S	1.935	S
	25							[2]949				949	S−	1.949	S−
	26								935	939		938	S−	1.938	S−
	27							[2]938				938	S−	1.938	S−
	28														
	29														
	30														
Dec.	1														
	2														
	3						[2]944					944	S	1.944	S
	4						968	964				966	S	1.966	S
	5							956	955	974	936	955	S	1.955	S
	6							950	963	959		959	S−	1.959	S−
	7							959	951	953		954	S	1.954	S
	8							945	973	969	949	959	S	1.959	S
	9														
	10						[2]965					965	S−	1.965	S−
	11							979	976	961	984	977	S	1.977	S
	12							960	956			959	S	1.959	S
	13							973	954	945		957	S−	1.957	S−
	14							945	946	948		946	S	1.946	S
	15		952	962	957	S−		942	954	945	971	949	S	1.953	S
	16						952	954				953	S	1.953	S
	17		907		907	U	964	960				962	S	1.962	S
	18						962	948				954	S	1.954	S
	19		[2]916		916	U+	968	950				959	S−	1.959	S−
	20								959	941		950	S	1.950	S
	21		881	891	886	U								1.886	U
	22						962					962	S−	1.962	S−
	23														
	24														
	25						944					944	S−	1.944	S−
	26														
	27														
	28	938	911	926	925	U+						925	U+	1.925	U+
	29														
	30	939	966	973	957	S	954	955				954	S	1.956	S
	31	962	947	958	955	S			972	959		966	S	1.960	S
1921.															
Jan.	1	957	957	958	957	S								1.957	S
	2														
	3														
	4						[2]968					968	S−	1.968	S−
	5						967	957				964	S−	1.964	S−
	6						[2]931					931	S	1.931	S
	7							954	954			954	S	1.954	S
	8	015	023	019	021	S		951	959			954	S	1.987	S−

TABLE 8.—*Harqua Hala and Montezuma values, October, 1920, to September 20, 1922*—Continued.

		H. H solar constant.					Montezuma solar constant.							Weighted mean.	Grade.
		1.3	2.0	2.7	Mean.	Grade.	1.5	2.0	2.5	3.0	Long.	Mean.	Grade.		
1921.															
Jan.	9														
	10	986	016	994	000	S−	968					968	S	1.984	S
	11														
	12		[2]940	948	943	S								1.943	S
	13		[2]969		969	S								1.969	S−
	14		[2]979	967	975	S	964					964	S−	1.970	S
	15						[2]962					962	S	1.962	S
	16		968		968	U								1.968	U
	17														
	18										932	932	S−	1.932	S−
	19	008	020	039	019	U								2.019	U
	20			949	949	U								1.949	U
	21		948		948	U								1.948	U
	22														
	23														
	24		[2]962	956	960	S−								1.960	S−
	25		960		960	U								1.960	U
	26														
	27														
	28														
	29		[2]948	935	944	S−								1.944	S−
	31		940		940	S−								1.940	S−
Feb.	1	924	921	923	923	S								1.923	S
	2		[2]964		964	S−								1,964	S−
	3		943		943	S−								1.943	S−
	4		852		852	U									
	5														
	6	940			940	S−								1.940	S−
	7														
	8		[2]943	934	940	S								1.940	S
	9														
	10		011		011	U									
	11	948	966	960	958	S	[2]956					956	S−	1.957	S
	12		990	974	985	S−	947					947	S−	1.966	S−
	13	957	971	942	960	S								1.960	S
	14	893			893	U									
	15	958	[2]961		960	S								1.960	S
	16	964	962	954	961	S								1.961	S
	17	953	958	954	955	S								1.955	S
	18	944	952	950	948	S−								1.948	S−
	19	938	913	930	926	S								1.926	S
	20	932			932	U								1.932	U
	21						[2]959					959	S−	1.959	S−
	22	944	943	967	948	S								1.948	S
	23	927	955	950	943	S−								1.943	S−
	24	928	951	946	941	S	[2]946					946	S	1.944	S
	25	942	964	954	953	S	[2]960					960	S	1.957	S
	26						[2]955					955	S	1.955	S
	27														
	28						[2]972					972	S−	1.972	S−
Mar.	1	969	969		969	U+	[2]963					963	S−	1.966	S
	2	938	945	945	942	S	954					954	S−	1.948	S
	3		991		991	U	[2]959					959	S−	1.959	S−
	4	999	014		007	U		945		962		956	S−	1.956	S−
	5	919	882	848	919	U−		943	910			943	S−	1.943	S−
	6		912		912	U	[2]946					946	S−	1.946	S−
	7		930	926	929	U	[2]952					952	S−	1.952	S−
	8	902	912	869	908	U									
	9														
	10						957					957	S−	1.957	S−
	11														
	12														
	13						949					949	S−	1.949	S−
	14							868				868	U		
	15														
	16	945	977	949	959	S−								1.959	S−
	17	908	920	908	913	S	[2]950					950	S−	1.925	S−
	18							[2]915				915	S	1.915	S
	19	998			998	U−	[2]948					948	S−	1.948	S−
	20														
	21														
	22	003			003	U−									
	23	941	938	906	940	S−								1.940	S−
	24	892	869		881	U									
	25		878		878	U−									
	26	946			946	U									
	27	922	915	926	920	S−								1.920	S−
	28	927	942	964	940	S−								1.940	S−
	29	941	981	949	959	S−								1.959	S−
	30														
	31	958	956	955	951	S								1.951	S
Apr.	1						[2]948					948	S−	1.948	S−
	2						957					957	S−	1.957	S−
	3														
	4														
	5						965					965	S−	1.965	S−
	6	927	936	916	928	S	953					953	S−	1.940	S−
	7	942	936	924	936	S								1.936	S
	8	[2]872			872	U	[2]950					950	S	1.950	S
	9	894			894	U	[2]950					950	S−	1.950	S−
	10	951	960	963	957	S	[2]931					931	S−	1.944	S−
	11														
	12	933			933	S−		923	917	926		922	S	1.927	S
	13	853													
	14						[2]956					956	S−	1.956	S−
	15	946	941	953	945	S	[2]947					947	S−	1.946	S
	16						[2]946					946	S−	1.946	S
	17	950	955	955	953	S	[2]952					952	S−	1.952	S
	18						[2]945					945	S−	1.945	S−
	19							934	908			920	S−	1.920	S−
	20		966	971	968	S−								1.968	S−

TABLE 8.—*Harqua Hala and Montezuma values, October, 1920, to September 20, 1922*—Continued.

	H. H. solar constant.					Montezuma solar constant.							Weighted mean.	Grade.
	1.3	2.0	2.7	Mean.	Grade.	1.5	2.0	2.5	3.0	Long.	Mean.	Grade.		
1921.														
Apr. 21								921			921	S–	1.921	S–
22	[2]956			956	S								1.956	S
23	[2]919			919	S								1.919	S
24	[2]933			933	S–								1.933	S–
25		[2]947		947	U+	946					946	S–	1.946	S
26	[2]944			944	S–								1.944	S–
27			[2]988	988	S–								1.988	S–
28	[2]951			951	S–								1.951	S–
29		[2]962		962	S–								1.962	S–
30		[2]945		945	S–								1.945	S–
May 1		958		958	S–								1.958	S–
2	950			950	S								1.950	S–
3	947			947	S–	[2]946					946	S–	1.946	S
4						[2]950					950	S	1.950	S
5								933			933	S–	1.933	S–
6							[2]950				950	S	1.950	S
7														
8	963			963	U	[2]955					955	S	1.955	S
9			972	972	U	949	938				944	S	1.944	S
10	962			962	U+								1.962	U+
11														
12	948			948	S–								1.948	S–
13		964		964	S–								1.964	S–
14	893			893	U	944	938				941	S	1.941	S
15		954	904	929	S–		[2]937				937	S	1.934	S–
16		[2]938		938	S–								1.938	S–
17														
18		963	[2]945	957	S								1.957	S
19		963	[2]969	963	S								1.963	S
20														
21								871	863		868	U–		
22	031			031	U–		[2]937				937	S	1.937	S
23	[2]962			962	S–	[2]935					935	S	1.948	S–
24														
25	958	954	973	959	S	[2]950					950	S	1.954	S
26			987	987	U								1.987	U
27	954	983		968	U								1.968	U
28	950	966		958	U	941					941	S–	1.941	S–
29	[2]951			951	S–								1.951	S–
30		953		953	U								1.953	U
31	809	783		796	U–									
June 1														
2														
3														
4		943		943	S–	[2]943					943	S	1.943	S
5	908	904	881	901	S–								1.901	S–
6	971	979		974	U								1.974	U
7	944	941	946	943	S				914		914	S–	1.928	S–
8	929	947		938	S		[2]938				938	S	1.938	S
9	952	943		947	S	951	932	914	928	967	938	S	1.942	S
10		906	914	910	S–								1.910	S–
11	[2]922			922	U+		[2]929				929	S	1.926	S
12														
13									937		937	S–	1.937	S–
14														
15														
16	938	945		941	S–								1.941	S–
17	949	941	927	941	S								1.941	S
18		934	949	939	S–	[2]950					950	S	1.945	S–
19	[2]953			953	U			929	930		929	S	1.938	S–
20	[2]962			962	U				933		933	S–	1.943	S–
21	906	931	959	927	S–	942					942	S–	1.934	S–
22	928	939		933	S	[2]955					955	S–	1.944	S–
23	918	927		922	S								1.922	S–
24	930		940	933	S–			950	930		943	S–	1.938	S
25	942	946	948	945	S	941	938				940	S	1.942	S
26	943	950		946	S		949	935			941	S	1.944	S
27	914	929	925	922	S			933	950		940	S–	1.931	S–
28		957	967	960	S–		938	946	946		944	S	1.952	S
29	927	946		937	S–	[2]952					952	S	1.944	S
30	907	905		906	S								1.906	S
July 1	924	906	915	915	U		948	937	935		939	S–	1.939	S–
2	936	912		919	U	955	941	943			946	S	1.946	S
3	[2]942			942	S–		[2]947				947	S–	1.945	S
4	[2]891			891	U								1.891	U
5	943	943		943	S								1.943	S
6	933	943		938	S								1.938	S
7	914	926		920	S–								1.920	S–
8	[2]937			937	U+								1.937	U+
9	921			921	U	[2]959					959	S	1.959	S
10	948			948	U	955	[2]968				964	S	1.964	S
11							954	927	930		936	S–	1.936	S–
12														
13						[2]951					951	S	1.951	S
14						[2]954					954	S	1.954	S
15										017	017	U	2.017	U
16														
17	[2]945			945	U								1.945	U
18	[2]961			961	U								1.961	U
19	[2]928			928	U								1.928	U
20	[2]940			940	U	946	957				952	S–	1.952	S–
21		[2]936		936	U	[2]959					959	S	1.959	S
22	[2]952			952	U	[2]951					951	S.	1.951	S
23	962			962	U								1.962	U
24														
25	[2]938			938	U	951	951				951	S	1.951	S
26	[2]920			920	U+	[2]925					925	S	1.923	S
27	929			929	U	[2]921					921	S–	1.925	S
28						955					955	S–	1.955	S–
29							[2]949				949	S	1.949	S
30														

TABLE 8.—*Harqua Hala and Montezuma values, October, 1920, to September 20, 1922*—Continued.

	H. H solar constant.					Montezuma solar constant.							Weighted mean.	Grade.
	1.3	2.0	2.7	Mean.	Grade.	1.5	2.0	2.5	3.0	Long.	Mean.	Grade.		
1921.														
July 31							938				938	S–	1.938	S–
Aug. 1														
2	[2]938			938	S	949	914	942		912	935	S	1.936	S
3														
4														
5														
6														
7		[2]945		945	S–								1.945	S–
8														
9	[2]916			916	S–								1.916	S–
10	[2]937			937	S–								1.937	S–
11	951			951	S–								1.951	S–
12	956	937		946	S–								1.946	S–
13														
14	944	948		946	S								1.946	S
15	947	945	930	943	S–								1.943	S–
16	947			947	S–								1.947	S–
17	990	841	867											
18														
19														
20														
21														
22														
23	948			948	U									
24	[2]948			948	U									
25	941			941	U									
26														
27														
28	919			919	S–								1.919	S–
29														
30	911	926	890	913	S–								1.913	S–
31	935	941	931	938	U									
Sept. 1	940	935	917	933	S								1.933	S
2			[2]929	929	S–								1.929	S–
3	941	949	931	942	S								1.942	S
4	936	947		941	S								1.941	S
5	934	946	942	940	S								1.940	S
6	944	936	920	936	S								1.936	S
7	934	952	944	943	S								1.943	S
8	936	934		935	S–								1.935	S–
9	944	959		951	S								1.951	S
10	952	955	945	952	S								1.952	S
11			[2]953	953	S–								1.953	S–
12		[2]947		947	S–								1.947	S–
13	945	954		949	S–								1.949	S–
14	945	958	955	952	S								1.952	S
15	[2]944			944	S–								1.944	S–
16		[2]941		941	S–								1.941	S–
17	948	947	942	946	S								1.946	S
18	951	948		950	S								1.950	S
19	939	945	948	943	S								1.943	S
20	938	949	949	945	S								1.945	S
21	943	949		946	S								1.946	S
22														
23	946			946	U								1.946	U
24	934	942	959	942	S–					937	937	S–	1.939	S
25	924	932		928	S–	968				963	965	S	1.946	S–
26	932	938	938	936	S								1.936	S
27	941	933	947	939	S			946	929	970	954	S	1.947	S
28						945			929	972	953	S	1.953	S
29														
30						939	951	953	976	956	955	S	1.955	S
Oct. 1														
2														
3	945	970	977	961	S	972		934	924	933	930	S	1.945	S–
4	934			934	U+	963	957	950		966	959	S	1.946	S
5	[2]932			932	S	945	935	931		939	938	S	1.935	S
6						949				983	960	S	1.960	S
7	947	948	954	949	S	959	945	925		967	952	S	1.951	S
8	923	949		936	S–	911		949		937	932	S	1.934	S
9	934	942	936	937	S		927			931	929	S	1.933	S
10	940	939	933	938	S					023	023	U	1.938	S–
11	922	945		933	U								1.933	U
12		932	928	933	U								1.933	U
13						931	957				944	S–	1.944	S–
14	935	914		925	U									
15	920	947	933	933	S								1.933	S
16		[2]945		945	S–			962			962	S–	1.953	S–
17	937			937	U								1.937	U
18	933	940		937	S–					001	001	U	1.937	S–
19	943	954	942	947	S								1.947	S
20		959		959	S–								1.959	S–
21	930	938	933	934	S								1.934	S
22	927			927	U					938	938	S	1.938	S
23							958	953		975	962	S	1.962	S
24														
25		942		942	U								1.942	U
26	952	957	940	952	S								1.952	S
27	933	947	970	946	S–								1.946	S–
28		962		962	S–								1.962	S–
29	941	965	961	955	S								1.955	S
30		[2]962		962	S–								1.962	S–
31		954	960	957	S								1.957	S
Nov. 1		[2]949		949	S–								1.949	S–
2	940	960	946	955	S								1.955	S
3		949	931	943	S–								1.943	S–
4		[2]946		946	S–	[2]952					952	S	1.949	S
5														
6														
7		957	977	967	S–								1.967	S–
8		[2]963		963	S–								1.963	S–

TABLE 8.—*Harqua Hala and Montezuma values, October, 1920, to September 20, 1922*—Continued.

Date	H. H. solar constant. 1.3	2.0	2.7	Mean.	Grade.	Montezuma solar constant. 1.5	2.0	2.5	3.0	Long.	Mean.	Grade.	Weighted mean.	Grade
1921. Nov. 9														
10		962	951	956	S–								1.956	S–
11			961	961	U+								1.961	U+
12														
13		972	967	969	S								1.969	S
14		969	972	970	S								1.970	S
15		944	951	947	S				907		907	U	1.947	S–
16						[2]944					944	S	1.944	S
17						962	969	974		950	962	S	1.962	S
18		[2]950		950	S	945	945	934		936	940	S	1.945	S
19		[2]957		957	S–	938	952	945		891	937	S	1.947	S
20		959	942	946	S	955	963	955			958	S	1.952	S
21		983	961	972	S–	950	957	963		950	955	S	1.963	S
22		981	963	975	S–								1.975	S–
23		[2]956		956	U	946	934			900	932	S	1.932	S
24							973	956			962	S–	1.962	S–
25		[2]964		964	U	944	945	921		954	944	S	1.944	S
26		972	959	968	U	950	948	951		943	948	S	1.948	S
27		962	968	964	S–	957	961	949			956	S	1.960	S
28		[2]954		954	S–	[2]963					963	S	1.959	S
29							[2]946				946	S	1.946	S
30														
Dec. 1						[2]962					962	S	1.962	S
2		957	948	954	S	945	941	940		952	944	S+	1.949	S
3		917	936	923	S–	953	949	935			946	S	1.935	S–
4		[2]935		935	S–	952	957	950			953	S	1.944	S
5						964	951	946			953	S	1.953	S
6						952	946	929			945	S	1.945	S
7		940	957	946	S	[2]968					968	S	1.957	S
8		949	965	954	S	[2]970					970	S–	1.962	S–
9		961	964	962	S	961	958	945		975	960	S	1.961	S
10						956	936	961			947	U+	1.947	U+
11		[2]940		940	S–	953	949	940			947	S	1.944	S
12		964	956	961	S								1.961	S–
13														
14						938	928	913			926	S	1.926	S
15		956	967	960	S–								1.960	S–
16														
17														
18														
19														
20														
21														
22														
23		956		956	S–								1.956	S–
24														
25														
26														
27														
28														
29														
30			940	940	U								1.940	U
1922. Jan. 1														
2														
3														
4		[2]931		931	S–								1.931	S–
5			941	941	S–								1.941	S–
6														
7														
8						923					923	S–	1.923	S–
9		928		928	S–								1.928	S–
10		945		945	U								1.945	U
11						947	903				932	U	1.932	U
12		[2]937		937	S–	937	904				922	S–	1.929	U
13		958	947	954	S	937	947				942	S–	1.948	S–
14		952		952	U	[2]941					941	S–	1.941	S–
15		941	941	941	S	[2]954	950				952	S	1.946	S
16		947	947	947	S	971	969				970	S	1.959	S–
17		[2]953		953	U	947	951	951			949	S	1.949	S
18		[2]952		952	U								1.952	U
19							958				958	S–	1.958	S–
20		940	937	938	S					936	936	S	1.937	S
21		939	941	940	S					959	959	S	1.950	S
22		954	939	946	S					941	941	S	1.943	S
23														
24		945	914	935	U+					957	957	S	1.946	S–
25		940	930	937	S					927	927	S	1.932	S
26		947	939	943	S–					936	936	S	1.939	S
27										944	944	S	1.944	S–
28		910	922	916	U					951	951	S	1.951	S
29														
30										987	987	S	1.987	S–
31										959	959	S	1.959	S–
Feb. 1														
2		934	933	934	S								1.934	S
3		939		939	U								1.939	U
4		946		946	U								1.946	U
5														
6		957	952	955	S–								1.955	S–
7														
8														
9														
10										910	910	S–	1.910	S–
11														
12		961	948	954	S					977	977	U	1.954	S–
13		956	952	955	S					938	938	S	1.946	S
14		932		932	U								1.932	U
15										967	967	S–	1.967	S–
16		953	963	958	S–								1.958	S–
17		950	945	947	S–								1.947	S–

TABLE 8.—*Harqua Hala and Montezuma values, October, 1920, to September 20, 1922*—Continued.

Date	H. H. solar constant. 1.3	2.0	2.7	Mean.	Grade.	Montezuma solar constant. 1.5	2.0	2.5	3.0	Long.	Mean.	Grade.	Weighted mean.	Grade.
1922. Feb. 18		947	957	952	S–					996	996	U	1.952	S–
19	[2]949			949	U					932	932	S–	1.932	S–
20		[2]948		948	S–								1.948	S–
21														
22		941		941	U					958	958	S	1.958	S–
23										930	930	S	1.930	S–
24										969	969	S	1.969	S–
25	945			945	U					936	936	S	1.936	S–
26														
27														
28		913	922	917	U					940	940	S	1.940	S–
Mar. 1		912	886	912	U								1.912	U
2		948	935	944	S					874	874	U	1.944	S–
3	[2]936			936	U					932	932	S	1.932	S
4		[2]939		939	S					059	059	U	1.939	S–
5		[2]909		909	U								1.909	U
6		[2]933		933	S–					880	880	U	1.933	S–
7										965	965	S	1.965	S–
8		932	927	930	S–					892	892	U	1.930	S–
9		888	823	888	U									
10		917	922	920	S–					003	003	U	1.920	S–
11										963	963	S	1.963	S–
12										947	947	S	1.947	S–
13		946	932	941	S–					908	908	S	1.924	S–
14	940			940	U								1.940	U
15														
16														
17						933					933	S–	1.933	S–
18		941	940	940	S								1.940	S
19		912	917	915	S								1.915	S–
20														
21														
22						[2]936					936	S	1.936	S–
23	[2]878			878	U	944	928			957	943	S–	1.943	S–
24	934	933		934	S–	[2]937	913				932	S–	1.933	S
25						[2]925	880				925	S–	1.925	S–
26	908	901		905	S								1.905	S
27	[2]913			913	S			919			919	S–	1.916	S
28														
29	[2]941			941	S–								1.941	S–
30														
31														
Apr. 1	[2]939			939	S–								1.939	S–
2	943	935		939	S–								1.939	S–
3	932	917	922	924	S								1.924	S
4														
5						936	[2]922				929	S	1.929	S
6						927	907	891			917	S	1.917	S
7	931	933		932	S	921	909	893		958	927	S–	1.930	S
8	923	895	857	923	U	[3]937					937	S	1.937	S–
9								935	877		935	S–	1.935	S–
10	[2]921			921	S–								1.921	S–
11	921	914		918	S–	[2]940	927				939	S	1.928	S
12		908	923	915	S–		[2]894	831			886	U	1.915	S–
13	[2]934			934	U				995		995	U		
14	928	921		925	S								1.925	S
15	921	910	899	912	S–								1.912	S–
16	[2]937			937	S–								1.937	S–
17	922	926		924	S								1.924	S
18						[2]935					935	S	1.935	S
19	918	902		910	S–	[2]935					935	S	1.923	S–
20	919	928		923	S								1.923	S
21														
22			[2]885	885	U	[2]918					918	S	1.918	S
23	[2]933			933	S–								1.933	S–
24	916	893	861	895	U								1.895	U
25														
26	918	910		914	S–								1.914	S–
27	887	861	825	864	U								1.864	U
28	[2]907			907	S–								1.907	S–
29						941					941	S	1.941	S–
30	950	937		943	S–		[2]912				912	S	1.927	S–
May 1	939	929		934	S–								1.934	S–
2	927	910	891	915	U								1.915	U
3	919	900		910	U								1.910	U
4	921	916		919	S–								1.919	S–
5	921		906	914	U								1.914	U
6														
7	932	959		945	U								1.945	U
8									910		910	S–	1.910	S–
9						908	867	857			886	S–	1.886	S–
10		920	923	922	U	939	934	912		958	936	S–	1.936	S–
11	939	930	918	931	S				[3]922		922	S	1.927	S
12	939	927		931	S	[2]932					932	S	1.932	S
13	929	940		934	S								1.934	S
14	922	923		923	S								1.923	S
15	[2]942			942	S–								1.942	S–
16	944	946	945	945	S								1.945	S
17		922	917	920	S–								1.910	S–
18		945	926	935	S–								1.935	S–
19	937	933		935	S	912	893	936			918	U	1.935	S–
20		942	938	940	S								1.940	S
21	934	942		938	S								1.938	S
22	935	931	919	930	S								1.930	S
23														
24														
25	942	919	913	927	U								1.927	U
26	938	936		937	S–								1.937	S–
27	942	932		937	S								1.937	S
28	900	894		897	S								1.897	S
29	917	900		908	U+								1.908	U+

TABLE 8.—*Harqua Hala and Montezuma values, October, 1920, to September 20, 1922*—Continued.

1922	H. H. solar constant. 1.3	2.0	2.7	Mean.	Grade.	Montezuma solar constant. 1.5	2.0	2.5	3.0	Long.	Mean.	Grade.	Weighted mean.	Grade.
May 30	^{2}932	....	....	932	U+	....	....	....	....	......	......	......	1.932	U+
31	915	913	....	914	U+	....	....	....	....	......	......	......	1.914	U+
June 1	931	914	....	922	S	....	903	906	....	......	905	S	1.913	S
2	^{2}931	....	....	931	S–	....	890	911	....	......	904	S	1.917	S–
3	942	944	941	943	S	915	924	....	....	......	919	S	1.931	S
4	938	928	....	933	S	....	....	....	....	......	......	......	1.933	S
5	927	931	....	929	S	....	....	....	....	......	......	......	1.929	S
6	934	944	944	940	S	....	....	....	....	......	......	......	1.940	S
7	941	940	....	940	S–	903	888	876	....	......	889	U	1.940	S–
8	^{2}942	....	....	942	U	....	....	....	....	......	......	......	1.942	U
9	^{2}944	953	....	948	S–	....	....	....	....	......	......	......	1.948	S–
10	937	951	949	945	S	....	....	....	....	......	......	......	1.945	S
11	....	941	....	941	S–	....	....	....	....	......	......	......	1.941	S–
12	....	....	....	......	......	....	....	....	....	......	......	......	......	
13	^{2}925	....	....	925	U	....	....	....	....	......	......	......	1.925	U
14	....	925	913	921	S	....	....	905	....	......	905	S–	1.913	S
15	920	926	913	921	S	....	898	923	....	934	922	S	1.922	S
16	923	936	....	930	S	^{2}931	....	....	....	......	931	S–	1.930	S
17	916	909	914	913	S	....	....	....	....	......	......	......	1.913	S
18	921	899	....	910	S–	....	....	....	....	......	......	......	1.910	S–
19	904	886	....	895	S	....	890	....	....	......	890	S–	1.892	S
20	882	881	....	882	S	....	....	....	....	......	......	......	1.882	S
21	^{2}880	....	....	880	S–	....	....	....	....	......	......	......	1.880	S–
22	....	....	....	......	......	....	....	....	....	......	......	......	......	
23	....	....	....	......	......	....	....	....	....	......	......	......	......	
24	^{2}897	....	....	897	U+	....	....	....	....	......	......	......	1.897	U+
25	....	....	....	......	......	....	934	900	....	......	923	S–	1.923	S–
26	892	898	....	895	S–	....	....	....	....	......	......	......	1.895	S–
27	908	962	009	908	U	....	....	....	....	......	......	......	......	
28	880	877	880	880	S–	....	....	....	....	......	......	......	1.880	S–
29	872	908	....	890	S–	....	901	890	....	......	897	S–	1.893	S
30	960	958	....	959	S	....	^{2}943	918	....	......	938	S–	1.948	S–
July 1	^{2}920	....	....	920	U+	920	898	....	....	......	913	S–	1.913	S–
2	^{2}864	....	....	864	U+	....	^{2}898	870	....	......	893	S–	1.893	S–
3	^{2}908	....	....	908	S–	....	....	....	....	......	......	......	1.908	S–
4	^{2}896	....	....	896	S–	....	....	....	....	......	......	......	1.896	S–
5	882	871	920	883	S–	....	....	....	....	......	......	......	1.883	S–
6	....	....	....	......	......	....	....	....	....	......	......	......	......	
7	....	....	....	......	......	....	....	....	....	......	......	......	......	
8	884	870	901	882	S	....	....	....	....	......	......	......	1.882	S
9	900	896	....	898	S–	....	....	....	....	......	......	......	1.898	S–
10	905	918	....	911	S–	....	....	....	....	......	......	......	1.911	S–
11	^{2}927	....	....	927	S–	....	....	....	....	......	......	......	1.927	S–
12	....	914	945	929	S	925	917	896	....	......	916	S–	1.921	S
13	....	943	930	936	S	....	....	^{2}888	....	......	888	S	1.912	U
14	905	916	913	912	S	....	....	....	^{3}913	......	913	S–	1.912	S
15	896	910	....	903	S–	^{2}929	....	....	....	......	929	S	1.920	S–
16	^{2}907	....	....	907	S–	....	....	....	....	......	......	......	1.907	S–
17	^{2}906	....	....	906	U	....	....	....	....	......	......	......	1.906	U
18	^{2}916	....	....	916	S–	....	....	....	....	......	......	......	1.916	S–
19	....	....	....	......	......	....	....	....	....	......	......	......	......	
20	892	....	....	892	U	....	....	....	....	......	......	......	1.892	U
21	950	943	....	947	U	....	....	....	....	......	......	......	1.947	U
22	926	933	929	929	S–	....	....	....	....	......	......	......	1.929	S–
23	^{2}925	....	....	925	S–	....	....	....	....	......	......	......	1.925	S–
24	^{2}926	....	....	926	S–	....	....	....	....	......	......	......	1.926	S–
25	....	....	....	......	......	....	....	....	....	......	......	......	......	
26	....	....	....	......	......	....	....	....	....	......	......	......	......	
27	^{2}918	....	....	918	U	....	....	....	....	......	......	......	1.918	U
28	928	....	....	928	U	....	917	887	....	......	907	S–	1.907	S–
29	....	....	....	......	......	^{3}927	....	....	....	......	927	S–	1.927	S–
30	^{2}903	....	....	903	U	....	....	....	....	......	......	......	1.903	U
Aug. 1	....	....	....	......	......	920	883	....	....	......	908	S–	1.908	S–
2	....	....	....	......	......	....	....	....	....	......	......	......	......	
3	911	901	933	912	S	....	....	....	....	......	......	......	1.912	S
4	913	917	....	915	S	....	....	....	....	......	......	......	1.915	S
5	^{2}889	....	....	889	U	....	915	....	....	......	915	S–	1.915	S–
6	....	....	....	......	......	....	....	....	....	......	......	......	......	
7	....	....	....	......	......	....	....	....	....	......	......	......	......	
8	....	....	....	......	......	931	....	....	....	......	931	S–	1.931	S–
9	....	....	....	......	......	....	....	....	....	......	......	......	......	
10	....	....	....	......	......	....	....	....	....	......	......	......	......	
11	....	....	....	......	......	....	....	^{2}903	....	......	903	S–	1.903	S–
12	^{2}921	....	....	921	S–	921	934	926	....	976	934	S	1.927	S
13	....	....	....	......	......	....	....	....	....	......	......	......	......	
14	943	946	....	945	S	....	....	....	....	......	......	......	1.945	S
15	^{2}920	....	....	920	U+	....	....	....	....	......	......	......	1.920	U+
16	905	....	....	905	U	....	....	....	....	......	......	......	1.905	U
17	....	....	....	......	......	....	....	....	....	......	......	......	......	
18	....	....	....	......	......	....	....	....	....	......	......	......	......	
19	....	....	....	......	......	....	^{2}907	....	....	......	907	S–	1.907	S–
20	....	....	....	......	......	....	....	....	....	......	......	......	......	
21	....	^{2}943	....	943	U	....	....	....	....	......	......	......	......	
22	....	....	....	......	......	....	....	....	....	......	......	......	......	
23	....	....	....	......	......	....	....	....	....	......	......	......	......	
24	....	....	....	......	......	....	....	....	....	......	......	......	......	
25	895	910	895	901	S–	....	....	....	....	......	......	......	1.901	S–
26	....	916	942	925	S–	....	....	....	906	......	906	S–	1.915	S–
27	....	912	937	920	S–	....	941	909	....	......	920	S–	1.920	S
28	908	935	971	931	U	937	....	....	....	......	937	S–	1.934	U
29	....	943	921	936	U	....	....	....	....	......	......	......	1.936	U
30	923	929	....	926	U	^{3}917	....	....	....	......	917	S–	1.917	S–
31	^{2}912	....	....	912	U+	....	....	....	....	......	......	......	1.912	U+
Sept. 1	935	939	....	937	U+	....	....	....	....	......	......	......	1.937	U+
2	....	....	....	......	......	....	....	....	....	......	......	......	......	
3	892	888	....	890	S–	....	....	....	....	......	......	......	1.890	S–
4	927	955	929	939	S–	....	....	....	....	......	......	......	1.939	S–
5	^{2}928	....	....	928	S–	....	....	....	....	......	......	......	1.929	S–
6	....	....	....	......	......	....	....	....	....	......	......	......	......	
7	....	....	....	......	......	....	....	....	....	......	......	......	......	
8	....	....	....	......	......	....	....	....	....	......	......	......	......	

[2] Small figures like exponents indicate number of observations used in obtaining the mean.

TABLE 8.—*Harqua Hala and Montezuma values, October, 1920, to September 20, 1922*—Continued.

1922	H. H. solar constant. 1.3	2.0	2.7	Mean.	Grade.	Montezuma solar constant. 1.5	2.0	2.5	3.0	Long.	Mean.	Grade.	Weighted mean.	Grade.
Sept. 9	919	946	....	928	S–	....	....	....	....	......	......	......	1.928	S–
10	919	900	891	905	S–	....	....	....	....	......	......	......	1.905	S–
11	^{2}916	....	....	916	S–	....	....	....	....	......	......	......	1.916	S–
12	^{2}900	919	946	916	S–	....	....	....	....	......	......	......	1.916	S–
13	....	....	....	......	......	....	....	....	....	......	......	......	......	
14	894	884	872	885	S–	....	....	....	....	......	......	......	1.885	S–
15	881	876	....	879	S–	936	....	....	....	......	936	U	1.879	S–
16	^{2}871	....	....	871	S–	936	920	925	....	......	927	S–	1.899	S–
17	....	857	856	857	U?	....	....	....	....	......	......	......	1.857	U?
18	^{2}866	....	....	866	S–	....	....	....	....	......	......	......	1.866	S–
19	860	830	804	860	U?	....	....	....	....	......	......	......	1.860	U?
20	861	873	....	867	S–	....	934	....	....	......	934	S–	1.900	S–

[2] Small figures like exponents indicate number of observations used in obtaining the mean.

DENSE FOG IN THE TRI-CITIES ON NOVEMBER 3, 1922.

E. E. UNGER, Observer.

[Weather Bureau Office, Davenport, Iowa, February 28, 1923.]

London had nothing on the Tri-Cities in the matter of fog this morning, up to nearly 9. One of the densest fog blankets which ever settled over this section enveloped the community, making it impossible for pedestrians and autoists to see even as far as across the street.—From *The Moline Dispatch*, November 3.

What may be characterized as the heaviest fog, or at least one of the heaviest, that ever occurred in the Tri-Cities (Davenport, Iowa, and Rock Island and Moline, Ill.), began as light fog at about 1 a. m. on Friday, November 3, 1922, changing to dense fog at about 2 a. m. and continuing dense to about 9 a. m. after which light fog prevailed to about 1 p. m.

Between the hours of 6 and 8 a. m., when the fog was apparently the heaviest, the curbings across the streets, shrubbery in yards, openings in buildings, and pedestrians were entirely invisible to one at distances of from 40 to 50 feet, while large objects, such as automobiles, buildings and the like could not be seen even faintly 50 to 75 feet away. Lights on automobiles, locomotives, street cars, and street lights could not be distinguished at distances of 125 to 300 feet away, depending on their intensity.

Different persons were called up on the telephone from the Weather Bureau office during the forenoon of November 3, in most cases before the fog had dissipated, and questioned relative to the density of the fog and the visibility. It is thought that most of the distances given are fairly accurate, due to the fact that generally they were supplemented in terms of width of street, length of block, width of city lot, etc., thus "Can not see house across street," "Could not see opposite curb from walk," "A person crossing the street becomes invisible when stepping up on opposite curb," "Could not see an automobile down town at the distance of the width of the street," "Could first see lights of approaching automobile about a half block away," and the like. The width of streets in the residential sections of the Tri-Cities average about 30 feet from curb to curb, while in the business sections they probably average about 60 feet.

The fog would compare favorably in intensity with the heavy fogs common at stations on the Atlantic and Pacific coasts. However, the formation of such a heavy fog in the Middle West is quite unusual. Light fogs in this section are not infrequent, especially during the autumn and winter months, but dense fogs where one can not see the faint outline of a building by day or a street light by night at a distance of 500 to 700 feet have never occurred

before in the Tri-Cities as far as is known, except possibly over very limited areas. It has been noted that, for the 30-year period, 1893 to 1922, inclusive, 10,956 days, the record at the Davenport station shows 213 days with dense fog. In other words, there has been only one day with dense fog out of every 51 days during the past 30 years.

Although the fog may have extended much farther, it is known that dense fog prevailed along the Mississippi River from Princeton, Iowa, about 20 miles upstream from Davenport, to Muscatine, Iowa, about 30 miles downstream. Its probable extent inland on either side of the Mississippi was from 2 to 5 miles. However, the area of denser fog apparently extended from east of Moline due westward and northwestward over the Tri-Cities to considerably beyond Nahant, a distance of about 10 miles, with the densest fog overlying parts of Moline and Rock Island. In Davenport, the dense fog seemed to be broken here and there by spots where one could see objects from 500 to 1,000 feet distant, and from where the cloudlike tops of the denser fog areas could be faintly distinguished. From the latter it was estimated that the thickness of the fog was probably 600 to 800 feet.

Referring to the weather map on the morning of November 3, it will be noted that high pressure prevailed over Iowa and Illinois and that there was little or no wind. The rainy weather of November 1, followed by entirely overcast skies until about 10 p. m. on November 2, resulted in high humidity, the relative humidity at 7 p. m. on November 2 being 79 per cent at a temperature of 54°. A cubic foot of air at a temperature of 54°, with a relative humidity of 79 per cent, contains approximately 3.73 grains (troy) of water vapor. By cooling, a cubic foot of air with a water vapor content of 3.73 grains (troy) reaches the point of saturation at a temperature of about 47.3°. From 7 p. m. of the 2d to 2 a. m. of the 3d, the temperature on the roof of the post-office building in Davenport dropped from 54° to 48°. It will be noted that the fog changed from light to dense at about 2 a. m. The temperature continued to fall showly till about 7:30 a. m., when the minimum of 42.4° was recorded.

The weather conditions overlying the Tri-Cities on November 3 as pictured on the morning map, that is, high pressure, clear skies over the surrounding territory, and little or no wind movement, together with the conditions that prevailed locally during the preceding two days, were ideal for the formation of very heavy fog over this vicinity. The visibility during the fog was undoubtedly lessened by the presence of city smoke.

WINDSTORM AT INDEPENDENCE, CALIF., FEBRUARY 12, 1923.

By C. D. ASHER, Observer.

[Weather Bureau Office, Independence, Calif., February 27, 1923.]

The storm described in this note was remarkable in that it seems to have been a violent downrush of wind from the high Sierras immediately to the westward of Owens River Valley, extending in a north-south line for a hundred miles or more. At the time of the windstorm there was a cyclonic system that had moved inland and a little southeastward from the Oregon coast during the early morning of the 12th, 300 miles due north of Independence. Since it occurred in the early morning hours, vertical convection must be eliminated as a contributing cause. The absence of any whirling motion as indicated by the distribution of the débris seems to preclude the idea of a tornado, although the barograph trace, Figure 3, is quite suggestive of pressure fluctuations in a tornadic storm.—EDITOR.

A mountain windstorm of unprecedented severity for eastern California occurred on the Sierra side of Owens River Valley during the morning of February 12, 1923. The wind at Independence blew at the rate of 70 miles per hour or more from 3:30 a. m. to 5:30 a. m., and reached a maximum of 80 miles per hour from the southwest at 4:20 a. m. The direction of the wind varied from southwest to west, coming directly down from the mountains—the highest section of the Sierras. Much damage was done by the wind in a strip of country about 100 miles long along the highway from Levinning Valley in Mono County to some distance south of Olancha in Inyo County, the damage varying in intensity at different points. In Long Valley and Round Valley and approaching Big Pine considerable damage was done, while Bishop, Big Pine, and Lone Pine, all in the northern part of Inyo County, escaped with practically no destruction. At Aberdeen, Fort Independence, Independence, Manzanar, Cartago, and Olancha much damage was done. The Sierra Power Co. sustained the greatest individual loss. Forty-three of their big transmission-line steel towers, foundations and all, were wrecked. More than 90 pole structures of this company between Bishop and Hot Creek went down. The steel towers that were wrecked stood in the vicinity of Olancha, between Olancha and Lone Pine and between Big Pine and control station.

The Inter-State Telegraph Co. was probably the next heavy loser. A great part of their line through the valley was blown down. Their loss will exceed $10,000.

Much damage was done to the power plant, belonging to the city of Los Angeles, at Division Creek and Cottonwood.

In the Aberdeen section north of Independence a number of houses were wrecked, but fortunately the occupants escaped injury; great damage was done to pumping plants, plowed fields, farming implements, trees, etc. In some cases the wind not only demolished houses but carried away household effects and wearing apparel.

The historic old mill on Oak Creek was demolished and the Mount Whitney Fish Hatchery further west on Oak Creek lost about half of its tiled roofing. In Independence the principal damage was to the new courthouse, although there was considerable private property loss. All homes were damaged to some extent. The courthouse damage will amount to about $7,000. At least 24 of the large plate-glass window panes were demolished by the storm. About 500 trees in town were uprooted and many others broken off.

Further down the valley, at Cartago, five 3-room houses were overturned or wrecked and the store at Olancha was demolished.

It was not a tornado but a straight blow, which was evidenced by the fact that all the wrecked trees and houses throughout the territory were blown in the same direction, namely, toward the northeast. The most remarkable fact about the storm effect was the amount of sand, rocks, and débris that the wind carried along with it and the force with which it was carried. The roads were swept clean of sand, soil, and pebbles, leaving only the larger rocks. At sone places windrows of gravel were made, leaving the ground not unlike an abandoned cornfield. Plowed fields were swept clean. The rain-

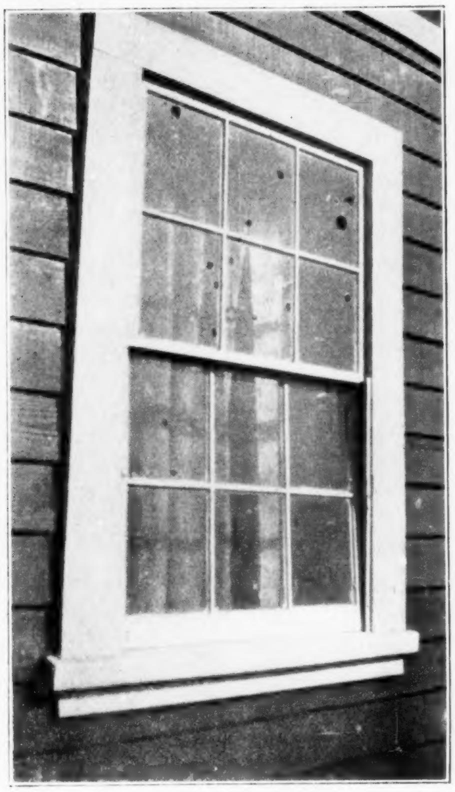


FIG. 1.—Windows penetrated by pebbles in windstorm at Independence, Calif.

FIG. 2.—Demolished ranch house at Fort Independence, Calif. Sierras in background.

gage and other painted instruments of the Weather Bureau equipment had the paint sand-blasted from them, as did some houses about town. The rain gage on the Weather Bureau grounds registered 0.15 inch of sand.

Figure 1 gives an idea of the velocity of the pebbles that were carried by the wind. The window is riddled

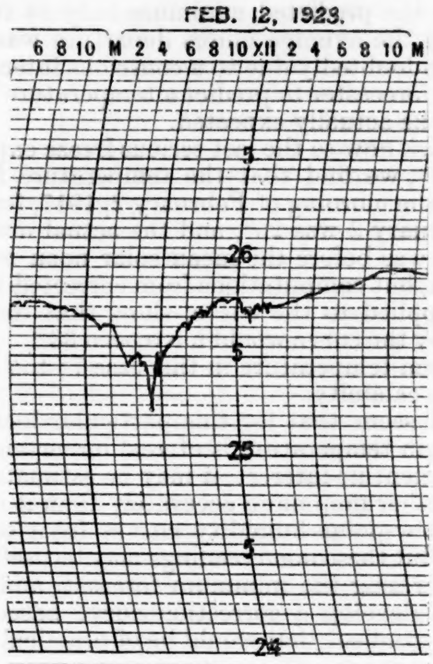


Fig. 3.—Barograph trace at time of windstorm at Independence, Calif., Feb. 12, 1923.

as if a machine gun had been turned on to it. The pebbles passed through without cracking the panes to the edge. Figure 2 shows a ranch house at Fort Independence after the storm.

The loss of the roof of the courthouse is explained as the result of internal pressure. No doubt if the windows had not blown in the roof would have held intact. All windows in this building were heavy plate glass. It was the foreign objects in the wind that broke the windows and not the force of the wind. The writer experienced a 110-mile hurricane, with air free of débris, at Tatoosh Island, Wash., during which no windows in the Weather Bureau building were broken. The storm at Independence blowing 80 miles an hour carried a blast of sand and pebbles through all of the windows in the Weather Bureau office facing the wind.

During the blow the sky was clear over the area of destruction, but a thick, heavy bank of stratus clouds hung over the eastern side of the valley, where but little effect of the wind is seen. During the evening of the 11th low temperature prevailed, but on the morning of the 12th the temperature increased with the wind. During the maximum phase of the storm the barograph trace for Independence shows (Fig. 3) a fall of half inch during the three hours preceding the highest wind. A fall of twenty-five hundredths inch took place during the 30-minute period preceding the peak of the storm. Light winds occurred at all the surrounding stations, except at Reno, Nev., about 200 miles to the northward. These facts lead to the conclusion that the influence of the storm was felt to the westward and northward only.

During the warm months the prevailing direction of the wind is up the valley, and in the other months it is down the valley. During the winter months moderately high winds from the northwest frequently occur. These winds, whether up or down the valley, are regular winds. Winds from the northeast or east seldom occur. The northwest winds are cold and dry and bring clear weather, and often continue at a rate from 25 to 50 miles an hour for several days at a time, but rarely reach destructive velocities. The destructive winds come from the west or southwest down from the mountains.

Since 1914 wind velocities of 60 miles an hour, or more, have occurred at this station six times.

Previous to this storm Owens River Valley has suffered but little from windstorms.

PREDICTING MINIMUM TEMPERATURES.

By Walter J. Bennett, Meteorologist.

[Weather Bureau Office, Tampa, Fla., February 19, 1923.]

The relation between relative humidity and dew point at the p. m. observation and the minimum temperature the next morning has been shown by Prof. J. Warren Smith and others to be a very real one. (Supplement 16, Monthly Weather Review.) Also it has been shown that for some localities the mean solar noon observation may be used with great accuracy, and thus give a determination of the minimum temperature early enough in the day to be of practical benefit. (E. M. Keyser, Monthly Weather Review, October, 1922.)

But it would be a mistake to put too much faith in the relative humidity and dew point observations, especially in cases when a drop in temperature is to be expected not from radiation alone, but from the bodily movement of a large mass of cold air. Such cases are of great importance in Florida.

A tolerably exact forecast of the minimum temperature is a real necessity for this section of the country.

A study of past records shows that when the temperatures mentioned in the next following paragraph are reached the results as indicated will follow. The temperatures are those recorded in the Weather Bureau thermometer shelter exposed on the roof of the post-office building in Tampa. Ground and grove temperatures will run from 2° to 10° lower within a few miles, depending upon local conditions.

A temperature of 40° to 42° indicates light frost with little damage; 38° to 40° means considerable damage to tender vegetables; 36° to 38° much greater damage; 34° to 36° a damage of 50 per cent or more to vegetables; 32° to 34°, almost complete destruction of vegetables, except when protected or in specially favored localities; 30° to 32° kills vegetables and damages the young growth on citrus trees; 28° to 30° will kill young trees unbanked; 26° to 28° will freeze some oranges, kill young trees and seriously damage young growth; 24° to 26° will freeze many oranges and damage trees; 22° to 24° means practically all oranges frozen and many trees frozen to the ground. Below 22° means extremely great damage to all groves not protected by heaters.

To determine how valuable the indications of the noon relative humidity and dew point would be in determining the minimum temperatures, dot charts were made for the several months of December, January, February, and March covering five years past, and curves were drawn free hand. Separate charts were first made for clear,

partly cloudy, and cloudy weather, but there was so little difference in shape and location of the several curves, that all observations were used for each month, regardless of the state of the sky.

The records of the office were then searched for all predicted minimum temperature during the past five years. Minima are predicted only when frost or near-frost temperatures are expected, and such predictions are seldom made on Sundays, because few or no reports are received Sunday mornings. In all, there were found 57 cases in which a definite prediction of the minimum temperature was made. The error between this predicted temperature and the actual minimum was then taken for each case. The relative humidity and the dew point at the noon observation were then consulted and the departure of the temperature indicated by the curve from the actual minimum was taken for each case.

The actually predicted minimum was within 4° of the real minimum 36 of 57 times, or 63 per cent. The minimum indicated by the dew-point humidity curve showed exactly the same percentage of accuracy. This was for the 57 special cases only, when the degree of cold was of real importance. If minimum temperatures were predicted by the curve every day, the average percentage of accuracy would be considerably greater.

The average error, taken regardless of sign, of the temperature forecast from the a. m. weather map was 4.1. The average error of the temperature indicated by the dew-point humidity curves was 4.3, nearly the same. Considering plus and minus departures, it was found that the minimum temperature was below the curve-indicated temperature 27 times, with an average minus departure of 4.4. It was above 24 times, and exactly equal 6 times. Incidentally, this almost equal distribution of plus and minus departures furnishes a fair check on the accuracy with which the curves were drawn.

Taking the temperatures actually forecast from the weather map, it was found that the real minimum went lower than the predicted minimum only 14 times out of the 57, and the average minus departure was only 1.9°. This was undoubtedly due to a conscious intention on the part of the forecaster to predict a temperature just a little lower than he actually expected.

Going back now to the last serious freeze experienced in this locality, we find that the temperature forecast for Tampa on the morning of February 2, 1917, for the morning of February 3 was 25°, and the actual minimum was 26°. This was before the mean solar noon observations were begun, but computations from corrected hygrograph readings applied to the curve, show that the minimum indicated by the curve would have been 33°. Estimating the minimum temperature in this case 7° too high would have been a calamity.

It would seem that for this particular locality, when the minimum temperature is of real importance and not merely of scientific interest, it may be estimated from the 8 a. m. weather map more accurately than it can be indicated by dew-point humidity curves from observations at noon. But these noon readings may be useful in checking or confirming the minimum forecast, and it may be possible to develop a correction curve based upon the barometric gradient that would be of practical value.

NOTES, ABSTRACTS, AND REVIEWS.

Paul Frederick Maxwell (1892-1923).

Paul Frederick Maxwell, in the strength and vigor of early manhood was overwhelmed by a snowslide on one of the steep slopes of the denuded area of the Wagon Wheel Gap, Colo. Experiment Station on March 5, 1923. When his body was found 5 hours later life was extinct. Mr. Maxwell left camp about 9 a. m. to make the regularly scheduled snow depth and density measurements on the denuded watershed. Not returning at the expected time his companions at the camp, Messrs. Weld and Torrence immediately set out in search of him. On arriving at the B-area they saw that a snowslide had occurred on what is known as "Snowstake area B-11;" and when they found snowshoe tracks leading to the slide their worst fears were realized. An hour's search failed to reveal the body, but finally the heel of a snowshoe was discovered projecting from a snow bank at the bottom of the slide, and the body was soon uncovered. Slowly and with difficulty the body was borne back to the camp, arriving there at 7:30 p. m., a little less than 12 hours from the time of his departure in the morning.

Mr. Maxwell entered the service of the Weather Bureau in 1916, and had seen service at North Head, Wash.; Boston, Mass.; and New Haven, Conn. From the last-named station he was transferred to Wagon Wheel Gap and was in his second year of duty at that station.

Snowslides have occurred in both watersheds at the Wagon Wheel Gap project while yet in timber due to the very great angle of the slopes, 35° in places. With the removal of the timber from the B-area the hazard of slides greatly increased and this fact was fully realized by the observers, who, nevertheless, with a fidelity that is extremely gratifying, carried on under these circumstances.

It was the writer's privilege to have known Mr. Maxwell personally and to have discussed with him the observational material of the project. His mind was keenly alive to the problems involved and he gave his best efforts toward their solution.

His memory will be treasured by his associates in the Weather Bureau as one who made the supreme sacrifice, just as truly as did those who gave up their lives on the scarred battlefields of France and Belgium. Mr. Maxwell is survived by his parents, Mr. and Mrs. W. D. Maxwell, of Baker City, Oreg., and by his wife and three small children. To all of these, his associates in the Weather Bureau extend their deep and lasting sympathy in the loss sustained by this tragic event.—*A. J. H.*

WARMER AIR IN REAR OF CYCLONE OF FEBRUARY 8, 1923.

The morning weather map for the United States, February 8, shows a depression of the barometer accompanied by the usual cyclonic wind circulation centered over the Great Basin. Immediately in the rear of the cyclone center is the legend "Warmer 20 degrees." The orthodox temperature distribution in cyclones which visit the United States is warm in front and cold in the rear; it is well known, however, that this distribution does not hold for the Pacific coast and the northern Plateau regions. The present case is of sufficient interest to warrant a few words of explanation.

On February 7 an anticyclone, sea-level pressure, 30.40 inches, occupied the region in question, but, by the next morning, it had vanished and the identical region was occupied by a cyclone as above mentioned. The

area immediately to the westward marked "Warmer" aroused my interest, and the observers at the two stations, Modena, Utah, and Winnemucca, Nev., have kindly supplied data of hourly temperatures, wind directions and velocities for the 24 hours ending with 8 a. m. 75th meridian time, February 8, 1923.

From these data it is inferred that the influence of the sea-level pressure distribution upon the speed of the wind was practically nil. The approaching cyclone, however, caused a shift in the wind from the east on the early morning of the 7th to west and southwest during the later hours of the 7th. The winds from the east were cold with temperatures at zero F. and below. With the shift of the wind into a westerly quarter on the 7th temperature rose sharply and to greater heights than had been attained on any of the preceding 4 or 5 days, although each of these days was free from clouds that might have intercepted the incoming solar radiation. One result of the high temperatures of the 7th was that the gain during the daylight hours was maintained during the night so that the minimum temperature on the morning of the 8th was 20° F. higher than on the immediately preceding morning; therefore, that which appears on the daily weather map as an area of "warmer 20 degrees" was in reality a failure of the night temperatures to sink to the low value of the preceding nights. It would be interesting, of course, to know what was the cause of the failure of the night temperatures to sink to the accustomed level of the period immediately preceding. A few clouds were observed at one of the stations about sunset of the 7th and the vapor pressure increased during that date to a maximum on the 8th. The rise in temperature on the 7th was clearly due to insolation unobstructed by any clouds whatsoever. At Winnemucca temperature rose from zero to 43° F. in 6 hours; at Modena from −9 to 36 in 10 hours. The opportunity for rising temperature on any of the five days preceding the 8th was evidently as great as on that date. Anticyclonic weather prevailed, however, and the slight gain by day was lost by night radiation to the sky. The interesting question arises what constituent of the atmosphere is responsible for checking the nocturnal radiation to which attention has has been called?—*A. J. H.*

TEMPERATURE AND MORTALITY IN NEW YORK CITY.[1]

[Reprinted from *Statistical Bulletin*, Metropolitan Life Insurance Co., February, 1923, vol. 4, no. 2.]

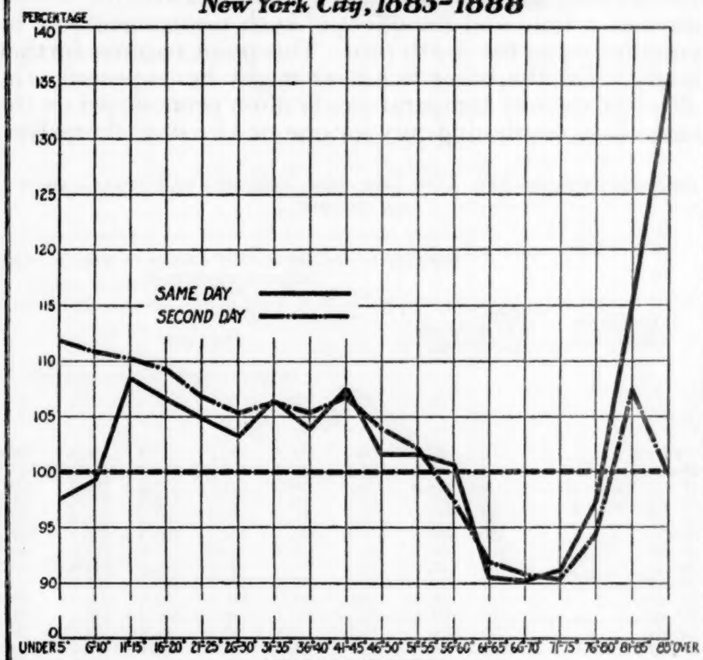
Three or four decades ago weather records were commonly published in conjunction with mortality data. This was due to a widespread conviction that the weather is the chief cause of seasonal variations in disease. Then came not only a new appreciation of the importance of nutrition, but also Pasteur's discovery of the fundamental part played by bacteria in disease. Investigators, medical men and public health officials were so impressed by the wonderful improvements in health which became possible through proper food and the control of bacteria that they almost overlooked the effects of the atmosphere. Lately, however, there have been signs of a revival of interest in the effect of weather and climate, and there seems to be good prospect of a return to a more balanced condition where the control of nutrition, parasitic organisms, and atmospheric environment will play more nearly equal parts in the world's campaign for health.

[1] A preliminary report from the committee on the atmosphere and man, National Research Council.

One sign of this change is the appointment by the National Research Council of a committee on the atmosphere and man. This committee has secured the cooperation of the New York City Department of Health and various life insurance companies in an investigation of the relation of the weather to deaths in New York City. For this purpose, the data for six years from 1883 to 1888 were chosen. That seems to be going back a long way, but, strange to say, those are the latest years for which statistics of daily deaths appear to be available in published form for any large city of the United States. Daily statistics are essential to any thorough understanding of the effect of the weather.

One phase of the joint investigation involves a study of the relation of deaths to temperature. The first

Percentage, Deaths* on Day with Specified Mean Temperature, and on Second Succeeding Day, of Average Daily Deaths for Year. New York City, 1883-1888



* At ages five and over

question to be answered was: How do the deaths vary at different temperatures? The crude materials that bear on the answer to this question are given in the following table. The 2,170 available days of the 6 years under discussion have there been divided into groups according to temperature. There were 5 days when the average temperature in New York City for day and night together was only 5° F. or less, 15 days with a mean temperature of 6° to 10° F. and so on up to the largest group containing 238 days when the thermometer averaged from 66° to 70°. The figures in the other columns show the deaths among persons over 5 years of age, expressed in percentages of the daily average deaths for the year in which each day with a given temperature occurred. The column marked 0 indicates the relative number of deaths, as thus defined, on the days when a given temperature prevailed, the next column shows the relative deaths one day later, and so on up to the thirteenth day.

The graph shows (1) the relative deaths, as above defined, on the day on which a given temperature occurs, and (2) on the second day thereafter.

We should, perhaps, eliminate the findings for the temperatures less than 10° and over 85° because of the small number of days involved. But, beginning with days whose mean daily temperature was 11°, the table (column 0) indicates that (1) the highest death rates occur on the colder days; (2) the excess mortality declines up to a temperature of about 60°; (3) the most favorable mortality is on those days when the temperature averages between 60° and 75°; and (4) there is a very rapid increase in mortality with increasing temperature beyond 75°.

Everyday observation and the table below suggest that cold weather does not exercise its maximum effect on the same day, but that such effect is deferred for several days. In this series the most pronounced effect of cold temperatures seems to occur two days afterward. The unfavorable effect of cold weather lasts, however, for many days after its occurrence. But this condition is evidently connected with the fact that cold weather persists for several days at a time and the effect of such persistence may be cumulative on the death rate. This point requires further study. On the other hand, as might be expected, the effect of warmer temperatures is most pronounced on the same day, continuing only for one or two days thereafter.

Daily mortality in New York City, 1883–1888, among persons 5 years of age and over.

Mean daily temperature.	Number of days.[1]	Mortality in per cent of daily average for year in which temperature occurred.						
		Same day.	Days after.					
		0	1	2	3	4	5	6
Under 5°	5	97.5	99.4	111.9	105.6	111.4	108.8	104.9
6°–10°	15	99.3	104.9	110.9	115.9	114.9	105.3	104.6
11°–15°	39	108.5	111.4	110.2	108.9	109.3	109.1	106.7
16°–20°	71	106.7	104.9	109.1	108.2	112.8	109.6	108.6
21°–25°	89	104.9	106.5	106.8	109.1	107.2	108.4	107.2
26°–30°	130	103.2	104.3	105.3	104.7	106.7	108.1	107.5
31°–35°	181	106.5	107.0	106.3	108.4	107.0	106.0	107.0
36°–40°	189	103.9	103.3	105.3	105.3	104.2	104.4	105.8
41°–45°	154	107.5	108.1	106.8	106.7	107.5	107.7	107.6
46°–50°	153	101.6	103.9	104.0	103.5	102.3	102.8	100.7
51°–55°	151	101.6	103.5	102.1	100.7	100.7	101.1	101.4
56°–60°	170	100.7	97.2	97.4	97.0	97.9	97.9	99.5
61°–65°	176	90.5	91.9	91.9	93.0	91.9	93.5	94.0
66°–70°	238	90.2	89.3	90.9	91.4	91.8	92.3	89.6
71°–75°	206	91.2	90.5	90.4	91.6	91.9	90.4	89.6
76°–80°	147	97.2	94.7	94.3	93.0	92.1	94.0	90.1
81°–85°	48	115.6	114.4	107.4	95.6	96.1	107.7	96.0
Over 85°	8	136.1	140.0	99.7	110.2	113.0	113.1	95.8

Mean daily temperature.	Number of days.[1]	Mortality in per cent of daily average for year in which temperature occurred.						
		Days after.						
		7	8	9	10	11	12	13
Under 5°	5	113.0	113.0	117.5	96.5	110.2	103.9	96.5
6°–10°	15	101.1	110.0	105.6	118.1	99.7	104.6	104.6
11°–15°	39	107.2	106.8	106.0	107.4	108.2	109.5	110.2
16°–20°	71	107.7	107.0	109.8	109.3	110.9	107.7	110.7
21°–25°	89	107.7	105.6	107.5	109.6	105.1	109.6	108.1
26°–30°	130	106.5	108.2	107.7	107.2	108.2	109.5	107.9
31°–35°	181	107.7	108.2	107.2	106.7	108.1	106.7	107.0
36°–40°	189	106.3	106.0	106.3	104.4	107.2	106.3	107.9
41°–45°	154	108.4	107.5	106.1	108.6	105.8	104.7	105.4
46°–50°	153	99.3	101.1	101.1	102.6	100.4	101.6	102.3
51°–55°	151	101.1	99.3	101.6	99.6	101.6	102.6	100.2
56°–60°	170	98.6	97.6	98.8	95.1	97.0	96.3	95.6
61°–65°	176	93.9	93.9	92.3	93.7	91.9	92.3	91.7
66°–70°	238	93.3	93.0	92.6	90.4	91.6	93.5	93.0
71°–75°	206	91.6	91.9	93.0	93.7	94.1	93.0	93.5
76°–80°	147	91.6	91.9	91.6	91.4	91.0	90.7	92.3
81°–85°	48	90.3	88.4	89.1	94.6	92.6	92.6	90.9
Over 85°	8	96.5	111.1	120.8	92.8	90.2	101.8	96.3

[1] Total days, 2,170.

During the years in question, the deaths at times of high or low temperature were 10.2 per cent higher than the deaths at temperatures of 60° to 70°. Similar conditions prevail to-day. If the death rate all the time were as low as it is when the temperature averages about 65°, one death out of every ten might be prevented. Low temperature, to judge from the table produces about seven times as much ill effect as high, for normally there are about seven days with a temperature below 60° for every day above 75°. It is not correct, however, to speak as if low temperatures alone were the cause of the deaths. Low temperature in itself is probably the cause of very few deaths. The effects often attributed to the cold may be due in many instances to improper indoor conditions. In fact, it is not improbable that the benefit derived from the stimulus of going into the cold outdoor air in winter is greater than the harm due to chills. Nevertheless, the fact remains that in New York City during the years under discussion the death rate during the coldest days of winter was more than 20 per cent greater than in days when the temperature was about 65°.

What all this seems to mean is that we know how to guard against low temperature by means of clothing, houses, fire, and exercise, and that in a civilized community it is very rarely necessary that anyone should come to much harm from low temperature in itself. On the other hand, we have not learned to guard against the harmful conditions which we ourselves produce in our attempts to ward off the cold. The graph * * * affords a suggestion of what happens when we light our fires. Notice the steepness of the curve between 60° and 40°. These are the temperatures when we begin to have fires in our houses. The steepness of the curve seems to mean that as soon as we start our fires we create conditions which promote bad health and as soon as we let them out in the spring we remove those conditions. It may be that a large part of the excess death rate in cold weather is preventable.

The committee on the atmosphere and man is working on the problem of all the conditions which raise the death rate at temperatures above or below the narrow ideal limits. It is not to be expected that the curves in the graph can ever be converted into straight lines. It is to be expected, however, that the high parts below 60° and above 75° can be greatly lowered.

The foregoing is a first study of a few of the facts available in the records of the committee. Further inquiries are being made into the effect of relative humidity and of interduirnal change in temperature. It is hoped also to have net correlation studies prepared when all of the necessary crude tabulations are completed.

THE DROUGHT IN ITALY DURING 1921.

By FILIPPO EREDIA.

[Abstracted from *Comptes Rendus*, February 5, 1923, pp. 402–404.]

The normal course of annual precipitation in the southern portion of Italy and in the islands is a maximum in winter and a minimum in summer; in the northern portion, two maxima, one in spring and the other in autumn, and two minima, one in summer and the other in winter.

During the year 1921, the annual march was wholly abnormal. There was but slight fall of snow in January and February, abundant rain in spring, and excess of rain in summer, and a remarkable deficiency beginning in September and continuing to the end of the year.

Most Italian droughts have been associated with the apparent joining of the Siberian and Atlantic high pressure areas across Europe. When this occurs, the Atlantic depressions pass farther to the north, and only occasionally may secondaries develop in the Mediterranean, producing rain in the central and southern parts of Italy. In the present case, the northern portion received almost no rain because the few depressions which did appear on the coast of northern Africa were prevented from producing precipitation in northern Italy by the high pressure above mentioned. They did produce some rain in the southern part, however.

The author believes that, in addition to the high pressure belt across Europe, unusually low pressure in the eastern Mediterranean was a contributing factor to the drought of 1921.

The intensity of this drought may be estimated from the comparison of rainfall records at Padua and Milan, which are the longest available. A study of these records shows that periods when the rainfall was less than one-third of the normal always occurred in winter, but never with the intensity shown in the months of October to December. The two longest periods in which no rain fell occurred in 1854, from January 13 to April 19, and in 1878, from January 1 to March 22. But never before has such a drought occurred in the early months of winter.—*C. L. M.*

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SOLAR OBSERVATIONS.

SOLAR AND SKY RADIATION MEASUREMENTS DURING FEBRUARY, 1923.

By HERBERT H. KIMBALL, In Charge, Solar Radiation Investigations.

For a description of instruments and exposures, and an account of the method of obtaining and reducing the measurements, the reader is referred to this REVIEW for April, 1920, **48**:225, and a note in the REVIEW for November, 1922, **50**:595.

From Table 1 it is seen that direct solar radiation intensities averaged below the normal values for February at Washington, and close to normal at Madison and Lincoln.

Table 2 shows that the total solar and sky radiation received on a horizontal surface averaged above the February normal at Madison and Lincoln, and at Washington during the last two weeks of the month. There was a decided deficiency at Washington during the first two weeks, however.

Skylight-polarization measurements obtained at Washington on five days give a mean of 63 per cent, with a maximum of 70 per cent on the 14th. These are above the average values for Washington for February. At Madison the ground was covered with snow throughout the month, and no measurements were obtained.

TABLE 1.—*Solar radiation intensities during February, 1923.*

[Gram-calories per minute per square centimeter of normal surface.]

Washington, D. C.

Date.	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon.
	75th mer. time.	Air mass. A. M.					Air mass. P. M.				Local mean solar time.
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Feb. 7	2.06				0.67						2.26
8	3.45						1.01	0.80	0.66		3.81
12	2.87	0.51	0.65	0.82	1.07						2.74
14	5.56	0.90	1.00	1.15	1.36	1.64	1.35	1.13	0.97	0.88	1.19
16	1.07	0.40	0.59	0.73	0.90		1.17	0.85	0.70	0.60	0.86
18	6.86			0.94	1.27						0.96
19	1.32	0.71	0.84	0.99	1.22	1.56	1.22				1.12
23	1.60		0.56	0.77	0.94						1.45
24	1.12						1.18	0.94	0.74		1.07
Means		**0.63**	**0.73**	**0.90**	**1.06**		**1.19**	**0.93**	**0.78**	**(0.74)**	
Departures		**−0.13**	**−0.10**	**−0.10**	**−0.12**		**−0.02**	**−0.07**	**−0.06**	**−0.02**	

* Extrapolated.

TABLE 1.—*Solar radiation intensities during February, 1923*—Continued.

Madison, Wis.

Date.	8 a.m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon.
	75th mer. time.	Air mass. A. M.					Air mass. P. M.				Local mean solar time.
	e.	5.0	4.0	3.0	2.0	*1.0	2.0	3.0	4.0	5.0	e.
	mm.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm.
Feb. 3	0.28	1.06	1.14	1.30	1.49	1.70					0.23
7	2.16							1.06			2.16
8	2.49	0 97	1.08								1.96
16	0.71	0.93	1.04								0.81
23	0.71		1.14	1.28							0.96
27	3.30						1.18				3.63
Means		**0.99**	**1.10**	**(1.29)**	**(1.49)**		**(1.18)**	**(1.06)**			
Departures		**+0.05**	**−0.03**	**+0.05**	**+0.11**		**−0.20**	**−0.13**			
Lincoln, Nebr.											
Feb. 3	0.63			1.32	1.46	1.65	1.46	1.29	1.14	1.01	0.58
5	0.66				1.30			1.14	0.91	0.86	2.26
7	1.24	1.00	1.09	1.30	1.39						2.62
13	1.88			1.16	1.34		1.34	1.12	0.89	0.73	1.19
15	0.79		0.83	1.07							0.86
16	0.91	1.03	1.08	1.31	1.47	1.65	1.45	1.24	1.08	0.96	0.96
17	1.37			1.20	1.37		1.46	1.26	1.14	1.00	1.32
24	5.56				1.29		1.30	0.97			5.16
27	2.87				1.41						2.49
Means		**(1.02)**	**1.00**	**1.23**	**1.38**		**1.39**	**1.17**	**1.03**	**0.91**	
Departures		**+0.04**	**−0.06**	**+0.01**	**−0.02**		**+0.03**	**−0.02**	**−0.01**	**−0.01**	

* Extrapolated.

TABLE 2.—*Solar and sky radiation received on a horizontal surface.*

Week beginning.	Average daily radiation. Washington.	Average daily radiation. Madison.	Average daily radiation. Lincoln.	Average daily departure for the week. Washington.	Average daily departure for the week. Madison.	Average daily departure for the week. Lincoln.	Excess or deficiency since first of year. Washington.	Excess or deficiency since first of year. Madison.	Excess or deficiency since first of year. Lincoln.
	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Jan. 29	88	174	212	−114	−29	−33	−1,940	−1,025	−573
Feb. 5	168	204	221	−54	−16	−48	−2,316	−1,138	−911
12	282	242	378	+39	+1	+81	−2,042	−1,131	−342
19	269	282	332	+5	+20	+8	−2,064	−990	−283

WEATHER OF NORTH AMERICA AND ADJACENT OCEANS.

NORTH ATLANTIC OCEAN.

By F. A. Young.

The average pressure for the month was considerably below normal at St. Johns, Newfoundland, while at land stations on the Atlantic coast of Canada and the United States, as well as in the Bermudas and West Indies, the departures were small. In the Azores the pressure was somewhat lower than usual, while in the British Isles the negative departures were unusually large, due to periods of atmospheric depression in the first and last decades of the month.

The number of days with fog was apparently not far from normal over the Grand Banks and off the American coast. It was reported on three days in the Gulf of Mexico, being comparatively rare over the remainder of the ocean.

The abnormally stormy weather that has prevailed over the North Atlantic since August, continued during February, and in the middle and eastern sections of the ocean the number of days with winds of gale force was in excess of anything experienced in years. In each of the two 5-degree squares between latitudes 45° to 50° and longitude 25° to 35°, gales were observed on 14 days, or 50 per cent, as compared with a normal percentage of 22, as shown on the Pilot Chart, and the figures for the two squares immediately to the east were only slightly less. A number of vessels reported from 4 to 8 separate disturbances in their voyage across the Atlantic, some of them being exceptionally severe, with highest force of wind from 11 to 12, Beaufort scale. The western section of the ocean fared considerably better than the middle and eastern, while in the vicinity of the American coast, the weather conditions were not far from normal.

On the 1st and 2d there was a fairly well-developed disturbance over the middle and eastern sections of the ocean, with moderate to strong westerly and southerly gales in the southern and eastern quadrants, respectively. Storm log follows:

French S. S. *Rochambeau:*

Gale began on the 1st, wind SE. Lowest barometer 29.33 inches at 9 p. m. on the 1st, wind WSW., 10, in latitude 47° N., longitude 39° 50′ W. End on the 2d, wind WNW. Highest force of wind 11 WSW.; shifts WSW.-WNW.

On the 3d there was an area of low pressure of limited extent central near latitude 45°, longitude 50°; this drifted slowly eastward and developed into an exceptionally severe and widespread disturbance, accompanied by rain, hail, and snow.

Charts VIII to XIII show the conditions for the period from February 5 to 10, inclusive. Storm logs:

Danish S. S. *Oscar II:*

Gale began on the 3d, wind SSW. Lowest barometer 29.03 inches at 5 a. m. on the 5th, wind SSW., 10, in latitude 59° 02′ N., longitude 9° 41′ W. End on the 5th, wind SW. Highest force of wind 10, SSW.; shifts SSW.-SW.

Danish S. S. *Arkansas:*

Gale began on the 3d, wind S. Lowest barometer 29.09 inches at 6 p. m. on the 6th, wind NW., 10, in latitude 46° N., longitude 31° 55′ W. End on the 7th, wind NW. Highest force of wind 11; shifts NW.-WNW.-NW.

Belgian S. S. *Carlier:*

Gale began on the 4th, wind SSE. Lowest barometer 28.88 inches on the 7th, wind WNW., in latitude 47° 53′ N., longitude 28° 10′ W. End on the 8th, wind NNW. Highest force of wind 12; steady WNW.

American S. S. *Blair:*

Gale began on the 4th, wind SW. Lowest barometer 29.20 inches at noon on the 8th, wind W., 6, in latitude 39° 48′ N., longitude 32° 53′ W. End on the 9th, wind W., 6. Highest force of wind 10, W.; shifts WSW.-W.

American S. S. *Mount Clay:*

Gale began on the 8th, wind SE. Lowest barometer 28.94 inches at 6 p. m. on the 8th, in latitude 47° 23′ N., longitude 23° 02′ W. End on the 10th, wind W. Highest force of wind 12; shifts SE.-W.

On the 5th northeasterly winds of gale force, with comparatively high barometric readings were reported from a limited region in the vicinity of Hatteras, and also off the Mexican coast, near Tampico.

At Greenwich mean noon on the 7th, Horta, Azores, reported a barometric reading of 29.48 inches, and a westerly wind, force 10, with a maximum velocity during the past 12 hours of 90 miles an hour.

On the 11th there was a well-developed disturbance central near latitude 42° N., longitude 45° W., that moved slowly eastward, accompanied by hail and snow. Storm logs:

Danish S. S. *Arkansas:*

Gale began on the 11th, wind S. Lowest barometer 29.09 inches at 6 a. m. on the 11th, wind SSW., 8, in latitude 43° N., longitude 43° 30′ W. End on the 13th, wind NW. Highest force of wind 12; shifts S.-SSW.-W.

Belgian S. S. *Carlier:*

Gale began on the 11th, wind SSE. Lowest barometer 28.49 inches on the 11th, wind SW., in latitude 45° 29′ N., longitude 40° 25′ W. End on the 13th, wind WNW. Highest force of wind 12; shifts SW.-WSW.

On the 15th westerly to northwesterly gales prevailed over the region between the 55th meridian and American coast, extending as far south as the 30th parallel. By the 16th the storm area had contracted somewhat, as it did not reach west of the 67th meridian, although the northern, eastern, and southern limits were about the same as on the previous day. Storm logs:

American S. S. *Editor:*

Gale began on the 15th, wind NW. Lowest barometer 29.45 inches at 8 a. m. on the 15th, wind NW., 8, in latitude 35°, longitude 61° 20′ W. End on the 16th, wind NW. Highest force of wind 10, NW.; steady NW.

French S. S. *Roussillon:*

Gale began on the 15th, wind WSW. Lowest barometer 28.96 inches at 6 p. m. on the 16th, wind W., 11, in latitude 41° 12′ N., longitude 59° 25′ W. End on the 15th, wind WNW. Highest force of wind 11; shifts W.-WNW.-NW.

From the 15th until the end of the month heavy weather prevailed over the eastern section of the ocean, although the extent and intensity of the storm area varied somewhat from day to day. Storm logs follow:

Dutch S. S. *Wieldrecht:*

Gale began on the 16th, wind WNW. Lowest barometer 29.43 inches at 10 a. m. on the 17th, wind NNW., 9, in latitude 46° 27′ N., longitude 25° 18′ W. End on the 18th, wind WNW. Highest force of wind 10, WNW.; steady WNW.

Belgian S. S. *Emanuel Nobel:*

Gale began on the 17th, wind NW. Lowest barometer 28.73 inches at 10 a. m. on the 17th, wind SW., 10, in latitude 49° N., longitude 32° W. End on the 18th, wind W. Highest force of wind 10; shifts SW.-NNW.

American S. S. *West Haven:*

Gale began on the 17th, wind SSW. Lowest barometer 28.64 inches at 5 a. m. on the 23d, wind W., 7, in latitude 45° 50′ N., longitude 24°

13′ W. End on the 23d, wind WNW. Highest force of wind 11; shifts W. by S.-W. by N.

British S. S. *Paul Paix:*

From the 15th, in latitude 51° 16′ N., longitude 11° 47′ W., to the 26th in latitude 39° 54′ N., longitude 32° 56′ W., a series of strong westerly gales with mountainous seas and violent squalls, sometimes of hurricane force, with rain and hail from NW. and W. and torrential rain from SW. Barometer ranged from 29.14 inches (lowest), in latitude 51° 07′ N., longitude 13° 35′ W., at 2 a. m. on the 16th to 30.16 inches (highest) in latitude 39° 34′ N., longitude 32° 50′ W., at 7 p. m. on the 26th.

American S. S. *Tripp:*

Gale began on the 18th, wind W. Lowest barometer 29.38 inches at noon on the 19th, wind NW., 9, in latitude 45° 25′ N., longitude 10° 27′ W. End on the 20th, wind W., 6. Highest force of wind 10, NNW.; shifts S.-SW.-W.-NW.

French S. S. *Chicago:*

Gale began on the 19th, wind W. Lowest barometer 28.73 inches at 2:35 a. m. on the 23d, wind W., 10, in latitude 48° 05′ N., longitude 31° 52′ W. End on the 26th, wind NW. Highest force of wind 11, W.; shifts W.-NW.

British S. S. *City of Shanghai:*

Gale began on the 18th, wind W. Lowest barometer 29.69 inches at 4 a. m. on the 19th, wind W., 9, in latitude 37° 28′ N., longitude 12° 30′ E. End on the 22d, wind W. Highest force of wind 11; steady W.

Dutch S. S. *Venezuela:*

Gale began on the 20th, wind WNW., 9. Lowest barometer 29.35 inches on the 23d, wind WNW., 11, in latitude 41° 26′ N., longitude 25° 37′ W. End on the 25th, wind NW., 6. Highest force of wind 11, WNW.; shifts WNW.-NW.

British S. S. *Chickahominy:*

Gale began on the 24th, wind WSW. Lowest barometer 28.95 inches at 3 p. m. on the 24th, wind WSW., in latitude 51° 38′ N., longitude 26° W. End on the 25th, wind WSW. Highest force of wind 10; steady WSW.

British S. S. *Valacia:*

Gale began on the 25th, wind S. Lowest barometer 28.25 inches at 3:30 a. m. on the 26th, wind SW., 12, in latitude 49° 40′ N., longitude 12° 24′ W. End on the 26th, wind WNW. Highest force of wind 12; shifts SW.-W.

French S. S. *Paris:*

Gale began on the 25th, wind SSE. Lowest barometer 28.15 inches at 2 a. m. on the 26th, wind SW., 8, in latitude 49° 36′ N., longitude 15° 11′ W. End on the 27th, wind NW. Higest force of wind 12; shifts SW.-W.-WNW.

On the 19th an area of low pressure was central about 300 miles east of St. Johns, N. F., with westerly gales in the southern quadrants. This LOW moved rapidly northeastward and by the 21st had joined forces with the eastern disturbance. Storm log:

Danish S. S. *Hellig Olav:*

Gale began on the 19th, wind SSW. Lowest barometer 29.25 inches at 8 a. m. on the 19th, wind SSW., 8, in latitude 44° 18′ N., longitude 45° 08′ W. End on the 21st, wind WNW. Highest force of wind 9; shifts SSW.-WNW.

On the 24th winds of gale force were encountered in mid-ocean as far south as the 33d parallel, as shown by following storm log:

Italian S. S. *Alberta:*

Gale began on the 24th, wind WNW. Lowest barometer 29.47 inches at 10 p. m. on the 24th, in latitude 32° 34′ N., longitude 50° 10′ W. End of gale on the 25th, wind N. Highest force of wind 9; shifts WSW.-N.

On the 27th there was a moderate disturbance off the Virginia coast that moved eastward with a fairly rapid rate of translation and on the 28th was central near the Bermudas. Storm log:

Italian S. S. *Alberta:*

Gale began on the 27th, wind SW. Lowest barometer 29.77 inches at 10:30 p. m., on the 27th, in latitude 34° 40′ N., longitude 60° 15′ W. End on the 28th, wind SW. Highest force of wind 10; shifts WSW.-NW.

NORTH PACIFIC OCEAN.

By WILLIS E. HURD.

In comparison with the tempestuous weather prevailing over the North Atlantic Ocean during Februray, 1923, that over the North Pacific was apparently much quieter. Ordinary winter gales were of frequent occurrence over the northern routes, but only a few dangerous storms occurred. The one pronounced storm of this character was that which began on the night of the 12th, and continued through the 13th and 14th. This gale swept the coast of British Columbia, Washington, and Oregon, several vessels being wrecked in the neighborhood of Cape Flattery, including the British S. S. *Tuscan Prince*, off Vancouver Island. On the night of the 13th the Weather Bureau station at Tatoosh Island reported a maximum wind velocity of 86 miles per hour from the northeast. The high winds were accompanied by heavy rain or snow, which contributed greatly to the danger at sea. The American S. S. *Colusa*, in dock at Tacoma on the 14th, reported 18 inches of snow on deck. This storm covered a wide expanse of the eastern part of the ocean.

From the 11th to the 28th of the month the Canadian S. S. *Canadian Inventor*, Capt. R. P. Roberts, was on a voyage from Japan to San Francisco. The observer, Mr. W. A. Attwell, thus described the weather experienced:

Weather and general conditions experienced usual to the month; dull and gloomy, with very little fine weather. Rough to heavy sea a part of the time, but not really very bad or worse than might be looked for during winter months. Very little storm or fog.

At Honolulu the weather up to the 19th was cool and sunny, but cloudiness and rain characterized the weather of the remainder of the month. The winds were prevailingly from the northeast and generally light, the average hourly velocity being only 6.7 miles per hour, as compared with the 19-year average of 8 miles for February. The one momentous occurrence to the Hawaiian Islands was the tidal wave which swept the east coasts and did considerable damage on the 3d, due to a seismic disturbance in the Pacific Ocean.

To the eastward of Hawaii the weather was generally good, and few gales occurred between there and the western coast of North America from California southward, except during the 14th to 16th. The American S. S. *Mahukona*, Capt. J. W. R. Steward, Kahului toward San Francisco, reported an entire and unusual absence of the trade winds on the trip, which began with the 9th.

From present information regarding the weather in Asiatic waters, the high-pressure area extending eastward from China was persistent until the 10th, and was again pronounced and steady after the 20th. Some moderate storm conditions occurred in this area during the interval, but most of the continental disturbances of the month entered the ocean from Manchuria and Siberia. On the 6th a depression appeared to the eastward of Luzon. It was over or near the Bonin Islands and southern Japan on the following day, whence it moved rapidly east-northeastward and combined with a great low-pressure area, which on the 8th and 9th was central approximately in longitude 165° E., between latitudes 35° and 40° N. Practically the whole central part of the ocean, or between 150° E. and 170° W., approximately, was at this time swept by gales, varying in force up to 10 as indicated by the vessel reports. The American S. S. *Broad Arrow*, Woosung, China, toward San Francisco, encountered moderate to whole gales on the 9th and 10th, with lowest pressure 28.51 inches, corrected, wind SW. 10, on the 9th, in latitude 38° 06′ N.,

longitude 163° 50′ E. The American S. S. *Stockton* on the same date experienced a south gale, force 10, lowest pressure 29.29 inches, in latitude 35° 14′ N., longitude 174° 20′ W.

On February 14 a cyclone issued from China, crossing lower Japan on the 15th and 16th, and proceeding thence on an easterly course. The British S. S. *Harold Dollar*, Capt. D. Clinton, Nagasaki toward San Pedro, was involved in this storm from the 16th, when in latitude 33° 56′ N., longitude 142° 15′ E., until the 18th, in latitude 35° 20′ N., longitude 151° E. The highest wind force experienced by this vessel was 10 from the NW. by W., on the 18th, lowest pressure 29.25 inches, on the 17th. The Canadian S. S. *Canadian Inventor* experienced gales in this storm area up to the 20th of the month, when near latitude 45° N., longitude 175° E. This huge cyclone is one of those few Pacific storms whose courses may be traced with considerable accuracy entirely across the ocean. After crossing the 180th meridian on the 23d, it moved slowly northeastward into the Gulf Alaska, was over Alaska on the 27th, and on the last day of the month was headed southeastward into the Canadian Northwest. During the last of its journey over the eastern Pacific it seems to have lost energy and few gales were reported within its area.

On the 25th of February pressure again began to fall to the eastward and northeastward of the Bonin Islands, and on the 28th the American S. S. *President Jackson*, Manila toward Seattle, while in latitude 46° 13′ N., longitude 166° 40′ E., observed a pressure reading of 28.79 inches in conjunction with a moderate breeze from the south. Notwithstanding this very low pressure, the cyclone produced no gales of importance so far as reports indicate.

There was some storm development of moment east of the 180th meridian early in the month. A depression lay to the eastward of Hawaii on the 1st, but it apparently died out shortly thereafter or merged with the LOW then central over the western Aleutians. On February 4 the British S. S. *Tyndareus* experienced a southerly gale, force 11, in latitude 49° 57′ N., longitude 157° 24′ W., lowest pressure 29.36 inches. But the great storm of this area, as well as of the entire ocean, was that of the 13th to 16th, which lashed the Canadian and northern United States coasts with gales and exhibited its fury over a large area of the adjoining ocean. The highest wind velocities given in vessel reports of this storm were those experienced by the Panaman S. S. *Pawnee*, while on a voyage from British Columbia to Australia. During the afternoon of the 14th and the early hours of the 15th, when in approximately 32° N., 148° W., this vessel was encountering southwesterly to west-southwesterly gales, maintained from force 10 to full hurricane strength, lowest pressure 29.06 inches, uncorrected. Early on the 16th, after a lull to moderate winds which lasted for several hours, the *Pawnee* was again beset by the storm, which now gave a maximum force of 11 WNW. at 4 a. m., after which it rapidly subsided and gave way to light airs with rising pressure.

The Aleutian LOW, as such, was strongly developed over the western Aleutians until the 5th of the month, after which it was almost completely displaced by high pressure. An anticyclone which had covered the Gulf of Alaska since the 1st, persisted until the 14th, at which time the center of high pressure shifted to the region of the central Aleutians, where it remained until near the end of the month. Meanwhile, on the 14th a strong cyclone covered much of the eastern part of the ocean as far north as Alaska, and pressure remained low in the gulf until gradually displaced by high pressure on the 28th. During this period the LOW received several accessions from traveling depressions. Cyclones entered the coast between northern United States and southern Alaska during February on the 11th, 18th, 22d, 23d, and 26th. The last four were offshoots from the LOW in the Aleutian area.

The North Pacific HIGH, with some fluctuations, persisted over the eastern area until the 12th. It redeveloped on the 21st and became fairly well established with its crest to the westward of Washington and Oregon. It remained practically stationary, spreading gradually in area, until the close of the month.

The general pressure conditions over the eastern portion of the ocean, as indicated by observations at the island stations, showed a continued rise in the Aleutian area and a further fall in the region of the Hawaiian Islands. The average pressure at Dutch Harbor, based on p. m. reports, was 29.80 inches, 0.24 inch above normal and 0.09 inch above the January average. The highest pressure recorded was 30.48 inches, on the 14th; the lowest 28.76, on the 4th. Absolute range, 1.72 inches, as compared with 1.46 in December and 1.58 in January. At Honolulu the average p. m. pressure was 29.96 inches, or 0.08 inch below normal. The corresponding values for January were 29.98 and 0.04, respectively. The highest pressure recorded was 30.09, on the 3d; the lowest, 29.82, on the 7th. Observations from Midway Island were not received on the 2d and the 4th to 9th, inclusive. The average pressure for the 21 days received was 29.99 inches, or approximately normal. The highest pressure was 30.22, on the 27th; the lowest, 29.82, on the 3d and 24th.

The percentage of fog along the American coast and over waters in the neighborhood increased slightly over that of January. Fog was observed from the 2d to the 7th principally between 37° and 51° north latitude and 140° and 151° west longitude. From the 15th until the 26th it was frequent along the coast between about 33° N. and Vancouver. There were scattered observances along the 47th parallel in middle longitudes. At Swatow, China, fog occurred on the 12th to 15th, and on the 19th, and some fog on various dates was reported from near the mouth of the Yangtse River.

NOTES ON WEATHER IN OTHER PARTS OF THE WORLD.

Newfoundland.—ST. JOHNS, February 6.—Railway and steamboat traffic have been abandoned owing to the severest midwinter conditions in Newfoundland for many years. * * * Tremendous ice floes are reported off the eastern coast and the Grand Banks, seriously impeding all ocean shipping.—*New York Herald, February 7, 1923.*

ST. JOHNS, February 15.—Enormous quantities of ice between Nova Scotia and Newfoundland and extending to the Grand Banks were reported by the British steamship *Sachem,* which arrived from Halifax.—*Washington Times, February 15, 1923.*

ST. JOHNS, February 24.—Because of the unusual ice blockade around the south coast of Newfoundland, which has prevented the movement of coastwise vessels, several settlements are short of food.—*New York Times, February 25, 1923.*

British Isles.—The weather generally was mild and wet. * * * The ground was muddy for more than half the month at most places, and at Valencia, Benson, and London was "wet" or "muddy" on every day. * * *

The general rainfall in the British Isles, expressed as a percentage of the average, was: England and Wales, 245; Scotland, 160; Ireland, 205; British Isles, 211.[1]

France.—In southern France, * * * the beginning of the month was marked by a drought * * *[1]

Portugal.—LISBON, February 11.—The whole Portuguese coast was littered with wreckage tonight following one of the worst storms in its history and great loss of life is feared among the fishing fleets. * * * Heavy rains have flooded the rivers.—*Washington Post, February 12, 1923.*

Switzerland.—The heavy falls of snow reported in the Alps during January continued until the 3d, and the warm weather set great masses of snow in motion, causing avalanches, in which several lives were lost. On the 6th, there was a great landslide into the Davozer See.[1]

Hungary.—BUDAPEST, February 12.—While a raging blizzard was halting the Simplon express, the Danube broke its embankments around Budapest, flooding the suburbs of Budapest and Kaposztasmagyer.

Eight thousand persons are homeless. * * * The bewildered population of the city has not experienced such an inundation since the great flood of 1830, when the town was practically swept away. * * *

The indications are that the flood has reached its height.—*Brooklyn Eagle, February 12, 1923.*

Arabia.—An unusually heavy rainstorm visited Aden on the 14th, giving a valuable supply of water.[1]

Africa.—About the same time [14th] heavy rains visited Orange Free State, and, up to the 14th, the total fall for 1923 already exceeded the rainfall of the whole of 1922. * * * On the 25th the Zambesi was in flood, interrupting railway communication.[1]

Brazil.—In Brazil rainfall was heavy in the north, including the dry northeastern region, averaging 85 mm. above normal. In central Brazil the fall averaged 36 mm. above normal, and in the south, exclusive of Rio Grande, 26 mm. above.[1]

[1] *Meteorological Magazine,* March, 1923, pp. 44–45.

[1] *Meteorological Magazine,* March, 1923, pp. 44–45.

DETAILS OF THE WEATHER IN THE UNITED STATES.

GENERAL CONDITIONS.

By ALFRED J. HENRY.

The month was cold and dry, but only moderately so. The single feature which stands out prominently was the unusually high average atmospheric pressure, a result, largely, of the occurrence of a single great anticyclone whose center occupied the northeastern Rocky Mountain slope from the 14th to the 17th, inclusive. See track No. VIIIB of Chart 1. From that region offshoots appear to have been detached, one of which moved to Texas, another to the Great Basin and the last to the East Gulf States.

The deficient precipitation was due, in some measure, to failure of cyclonic systems to move inland from the Pacific, as well as to a lack of intensity in the systems which appeared in the Canadian Northwest or developed over the southern Plateau region.

CYCLONES AND ANTICYCLONES.

By W. P. DAY.

The anticyclones (HIGHS) outnumbered the cyclones (LOWS) during February. This was rather unusual, and due to the great magnitude of the air masses released from the polar cap, which frequently covered much of the country and shunted the LOWS beyond the limits of observation. One of these great high-pressure areas surged down from Alaska and the Mackenzie Valley on the 13th and with various reinforcements spread eastward and southward over the United States, virtually controlling the weather over the entire country until the 18th. The highest reported barometer reading was 31.18 inches at Miles City, Mont., on the 14th. After the departure of the North Pacific storm of the 11th-15th no low-pressure area was charted within the confines of the United States until the 18th, showing the complete dominance of this great HIGH.

Cyclones.	Alberta.	North Pacific.	South Pacific.	Northern Rocky Mountain.	Colorado.	Texas.	East Gulf.	South Atlantic.	Central.	Total.
February, 1922	7.0	1.0	......	......	2.0	1.0	1.0	......	1.0	13.0
Average number, 1892–1912, inclusive	3.1	2.3	1.0	0.2	1.5	1.5	0.5	0.2	0.7	11.0

Anticyclones.	North Pacific.	South Pacific.	Alberta.	Plateau and Rocky Mountain region.	Hudson Bay.	Total.
February, 1922	5.0	......	8.0	2.0	1.0	16.0
Average number, 1892–1912, inclusive	0.8	0.5	4.7	1.2	0.6	7.8

FREE-AIR SUMMARY.

By L. T. SAMUELS, Meteorologist.

In direct contrast to the mean free-air temperatures for January, 1923, those for February fell, almost without exception, below their normal values. (See Table 1.)

It will be observed in the table that at Ellendale, the northernmost station, the negative departures remained practically the same in amount from the surface to the highest altitude. This persistence of large negative departures disappeared at the other stations in proportion to their distance from Ellendale. Thus at Groesbeck, farthest south the departures in the highest levels were positive (although extremely small), this being the only case of positive departures for the month. At this station previous minimum temperature records for February were broken during the first week in the month from the surface to 2,000 m. altitude, when a severe cold wave overspread this region.

The relative humidity for the month averaged close to normal for all stations and levels, the departures in nearly every case being less than 10 per cent. At Groesbeck the prevalence of positive departures for all levels was conspicuous.

The vapor-pressure departures were small and negative for all stations except Groesbeck where positive departures were found at all levels.

In Table 2 are shown the resultant wind velocities and directions together with the normal values. The high resultant velocities as compared with the normals generally, are noticeable and of interest. It is also apparent that in most cases the north component for the month exceeded the normal, thus showing the usual close connection with the negative temperature departures mentioned previously. The resultant direction for the month at Groesbeck is interesting because of the regular veering found with increasing altitude. This is well shown in the table, beginning at the surface with N. 40° E, then turning steadily clockwise to the 5,000 m. level when N. 45° W. is found, embracing three complete quadrants.

Gales were recorded on a number of occasions at various stations and altitudes. The following reported velocities of 40 m. p. s. or more. It must not be inferred, however, that equally high or higher velocities did not occur on other days during the month as well, but observations at those times were impracticable owing to low clouds, precipitation, etc.

Station.	February.	Velocity.	Direction.	Altitude.
		M. p. s.		*M.*
Aberdeen, Md	5	40	WSW	1,400
Fort Benning, Ga	8	40	W	1,700
Bolling Field, D. C	14	40	NW	600
Fort Bragg, N. C	23	42	W	1,500
Chanute Field, Ill	14	47	WNW	500
Due West, S. C	14	40	W	5,700
Do	16	52	WNW	5,300
Do	17	40	WNW	6,500
Edgewood Arsenal, Md	15	40	NW	350
Kelly Field, Tex	26	42	SW	2,000
Fort Scott, Ill	5	41	WSW	2,300
Lansing, Mich	23	42	WNW	5,100
Washington, D. C	14	49	W	2,100
Camp Lewis, Wash	17	40	S	1,500

On the 3d the observer at Due West made the following note in connection with the kite flight of that day:

> Definite NE.-SW. squall line in NW. at 9:45 a. m. with ugly wind-torn clouds and rain curtain. Roll cloud above reel house at 10:01 a. m. Kite No. 17 veered rapidly and squall wind reached it at 10:05 but upper wind remained WSW.

It seems probable that the condition described was of a comparatively local nature. The actual arrival of the high-pressure area and its attendant cold wave, which at the time was moving in from the west, did not occur until about 3 p. m. or five hours later, as shown by the temperature and wind records.

Somewhat similar conditions prevailed at Drexel on the 5th–6th when a diurnal series of kite flights was made. At the beginning of the series at 8 a. m. on the 5th the surface wind was SSW. and veered gradually to W. by 5 p. m. At 6 p. m. it suddenly changed to NNW. as a result of the approach of a high-pressure area. The kite record made at this time clearly shows that this northerly wind first arrived at the surface and then successively in the higher levels. The records also indicate that the temperature drop, although considerable at the surface, did not extend above 1,200 m. altitude which is about the average height at which diurnal temperature changes cease.

A series of kite flights was obtained at Ellendale on the 16th–17th during abnormally high-pressure conditions. Pressure had been high over this region since the 14th. The magnitude of this high-pressure area is well shown by its persistence to at least 2,000 m. on the free-air pressure map for that level. From the kite records at Ellendale and Drexel it is found that this persistence extended even to 2,500 m., the pressure to this level remaining higher over Ellendale than over Drexel. The temperature gradient throughout this series had a lapse rate considerably less than was found for anticyclones for Drexel.[1] The average temperature for the series at 2,500 m. was 2.4° C. higher than the average at the surface. The relative humidity decreased from about 85 per cent at the surface to between 40 and 50 per cent in the upper levels from the beginning of the series to 6 p. m. After that time the decrease with altitude diminished with increasing cloudiness until the 7th flight when a humidity of 93 per cent was recorded, at 1,700 m., the highest level reached in this flight. The 8th and last flight indicated a marked decrease above the cloud layer, the humidity dropping to less than 10 per cent above 2,000 m.

In connection with the severe storm of the 13th–14th the following remarks of the official in charge at the Ellendale station are of special interest:

> An extreme blizzard condition developed on the morning of the 13th and held control until toward late afternoon of the 14th. During the 13th, station duties were extreme, and going the short distance to and from the reel house there was danger of becoming lost in the storm. Only one kite was put up in the storm this day and it required two men to pull it down. While the altitude was low it was the greatest possible to obtain, the wind velocity being about 36 m. p. s. On the 14th the blizzard conditions moderated somewhat, although during the flight objects were not visible for more than 600 meters along the ground and the temperature was about −25° C. As the wind was less aloft we were able to obtain a higher flight on the 14th. Snow entered the reel house so that the reel and all objects were covered with about 2 inches of snow and it was necessary to use a steel wire brush to clean the cog-wheels before the reel could be operated. The ring switch under the reel house operated successfully although it was covered with about 3 inches of snow. This snow was so fine, that, driven by a gale, it passed in one part of our office building through the wall by way of the outside weatherboarding and sheathing and through the grooving of the boards forming the inside walls of the office and there along the joining point of the boards clotted and hung downward for about an inch. Between the storm windows and our inside windows the snow filled the space so that only the upper half was open. The snow froze to the eyelashes of the men until their eyes were blinded. On the mornings of the 13th and 14th it was hardly possible to reach the station and would not have been at all safe except for being able to follow the power line leading to the station from Ellendale. One could not see between the power line poles and a house could not be seen 75 meters away during the afternoon of the 14th.

[1] Vertical temperature distribution in the lowest 5 km. of cyclones and anticyclones. By W. R. Gregg, MO. WEATHER REV., 47: 647-648.

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during February, 1923.*

TEMPERATURE (°C.).

Altitude. m. s. l. (m.)	Broken Arrow, Okla. (233m.) Mean	Departure from 5-yr. mean.	Drexel, Nebr. (396m.) Mean	Departure from 8-yr. mean.	Due West, S. C. (217m.) Mean	Departure from 2-yr. mean.	Ellendale, N. Dak. (444m.) Mean	Departure from 6-yr. mean.	Groesbeck, Tex. (141m.) Mean	Departure from 5-yr. mean.	Royal Center, Ind. (225m.) Mean	Departure from 5-yr. mean.
Surface	3.4	−1.6	−6.3	−1.9	9.0	−0.9	−13.7	−2.6	9.4	−0.8	−5.4	−3.1
250	3.3	−1.6			8.8	−0.9			9.1	−0.7	−5.6	−3.1
500	1.5	−1.8	−6.8	−1.9	7.3	−1.0	−13.8	−2.7	8.4	−0.4	−7.8	−3.4
750	0.8	−1.5	−7.7	−2.4	6.3	−1.1	−13.7	−3.0	8.2	−0.3	−8.6	−3.4
1,000	0.5	−1.4	−7.7	−3.0	5.6	−1.1	−13.1	−2.9	7.4	−0.8	−8.8	−3.2
1,250	0.4	−1.3	−7.5	−3.4	5.0	−0.9	−12.5	−2.9	6.6	−1.0	−9.4	−3.2
1,500	−0.2	−1.2	−7.5	−3.3	4.5	−0.7	−12.4	−3.0	5.9	−1.0	−9.6	−3.0
2,000	−1.6	−1.2	−8.2	−3.0	2.4	−0.9	−13.4	−2.9	5.0	−0.1	−10.2	−2.5
2,500	−3.7	−1.0	−10.0	−2.7	−0.3	−1.0	−15.2	−2.7	3.3	+0.3	−11.9	−2.7
3,000	−6.2	−1.0	−12.2	−2.4	−2.3	−1.0	−18.2	−3.0	0.8	+0.2	−13.7	−2.3
3,500	−7.6	−0.2	−14.6	−2.1	−4.9	−1.7	−20.3	−2.5	−2.0	−0.3	−15.7	−1.8
4,000	−10.4	0.0	−16.0	−0.7			−23.1	−2.7	−4.0	+0.1	−18.5	−1.8
4,500							−26.5	−3.3	−5.5	+0.3		
5,000									−8.1	+0.3		

RELATIVE HUMIDITY (PER CENT).

Altitude. m. s. l. (m.)	Broken Arrow Mean	Departure	Drexel Mean	Departure	Due West Mean	Departure	Ellendale Mean	Departure	Groesbeck Mean	Departure	Royal Center Mean	Departure
Surface	62	−4	71	−6	66	−4	88	+6	80	+5	79	+2
250	62	−4			66	−4			78	+5	79	+2
500	61	−4	70	−6	65	−3	85	+4	72	+2	81	+4
750	58	−4	67	−5	64	−3	74	−1	70	+4	78	+3
1,000	55	−2	63	−4	62	−4	68	−3	72	+10	74	+3
1,250	53	0	61	−2	62	−3	63	−4	72	+13	71	+4
1,500	53	+2	58	−1	61	−2	58	−5	67	+12	67	+4
2,000	49	0	57	+2	59	0	55	−6	55	+7	57	+1
2,500	45	−3	55	+2	56	−3	56	−6	50	+6	53	−1
3,000	40	−4	51	−2	53	−2	54	−6	48	+6	49	−5
3,500	34	−6	46	−7	54	+1	44	−14	50	+10	43	−11
4,000	32	−6	43	−7			39	−18	43	+8	39	−14
4,500							41	−13	24	+2		
5,000									22	+2		

TABLE 1.—*Free-air temperatures, relative humidities, and vapor pressures during February, 1923*—Continued.

VAPOR PRESSURE (*mb.*).

Altitude. m. s. l. (m.)	Broken Arrow, Okla. (233m.) Mean	Departure from 5-yr. mean.	Drexel, Nebr. (396m.) Mean	Departure from 8-yr. mean.	Due West, S. C. (217m.) Mean	Departure from 2-yr. mean.	Ellendale, N. Dak. (444m.) Mean	Departure from 6-yr. mean.	Groesbeck, Tex. (141m.) Mean	Departure from 5-yr. mean.	Royal Center, Ind. (225m.) Mean	Departure from 5-yr. mean.
Surface	5.06	−0.99	2.81	−0.85	8.33	−10.0	2.09	−0.31	10.41	+0.49	3.42	−0.80
250	5.02	−0.98			8.23	−0.98			9.93	+0.49	3.36	−0.80
500	4.38	−0.94	2.68	−0.80	7.48	−0.84	2.00	−0.36	8.86	+0.44	2.94	−0.72
750	3.94	−0.75	2.42	−0.72	6.94	−0.85	1.72	−0.49	8.38	+0.65	2.72	−0.60
1,000	3.72	−0.48	2.20	−0.75	6.48	−0.82	1.66	−0.49	8.00	+1.01	2.53	−0.54
1,250	3.52	−0.28	2.14	−0.67	6.18	−0.62	1.63	−0.46	7.39	+1.10	2.27	−0.47
1,500	3.27	−0.18	2.01	−0.58	5.73	−0.53	1.41	−0.55	6.31	+0.86	2.06	−0.38
2,000	2.64	−0.19	1.74	−0.43	4.50	−0.38	1.19	−0.50	4.38	+0.27	1.58	−0.37
2,500	2.04	−0.34	1.42	−0.37	3.33	−0.55	1.00	−0.43	3.65	+0.35	1.35	−0.32
3,000	1.41	−0.47	1.07	−0.40	2.70	−0.37	0.64	−0.45	3.12	+0.35	1.15	−0.23
3,500	1.04	−0.45	0.69	−0.46	2.56	−0.36	0.34	−0.47	2.79	+0.56	0.95	−0.12
4,000	0.78	−0.34	0.45	−0.39			0.21	−0.44	2.19	+0.46	0.74	−0.08
4,500							0.12	−0.37	0.99	+0.09		
5,000									0.80	+0.09		

TABLE 2.—*Free-air resultant winds (m. p. s.) during February, 1923.*

Altitude, m. s. l. (m.)	Broken Arrow, Okla. (233m.) Mean. Dir.	Vel.	5-year mean. Dir.	Vel.	Drexel, Nebr. (396m.) Mean. Dir.	Vel.	8-year mean. Dir.	Vel.	Due West, S. C. (217m.) Mean. Dir.	Vel.	2-year mean. Dir.	Vel.
Surface	N. 27° E.	2.1	N. 19° W.	0.6	N. 67° W.	2.7	N. 66° W.	1.6	S. 78° W.	1.8	S. 75° W.	1.7
250	N. 30° E.	2.1	N. 22° W.	0.4					S. 79° W.	2.0	S. 78° W.	1.8
500	N. 43° E.	1.6	N. 84° W.	0.4	N. 62° W.	3.5	N. 71° W.	2.2	S. 78° W.	3.4	S. 82° W.	3.5
750	N. 67° E.	0.5	S. 53° W.	1.6	N. 58° W.	6.7	N. 70° W.	4.4	S. 75° W.	4.8	S. 80° W.	5.2
1,000	N. 83° W.	0.8	S. 61° W.	2.7	N. 55° W.	8.6	N. 67° W.	5.8	S. 76° W.	5.8	S. 76° W.	6.6
1,250	N. 80° W.	2.0	S. 86° W.	3.6	N. 55° W.	10.5	N. 66° W.	7.0	S. 81° W.	6.9	S. 81° W.	8.3
1,500	N. 75° W.	4.3	N. 88° W.	4.5	N. 56° W.	12.1	N. 66° W.	9.0	S. 77° W.	8.9	S. 77° W.	10.1
2,000	N. 76° W.	6.8	N. 79° W.	6.8	N. 62° W.	12.8	N. 69° W.	10.8	S. 82° W.	13.9	S. 80° W.	13.9
2,500	W.	12.3	N. 75° W.	7.9	N. 62° W.	15.7	N. 69° W.	13.0	S. 83° W.	15.4	S. 82° W.	15.8
3,000	N. 81° W.	16.7	N. 82° W.	12.0	N. 69° W.	15.4	N. 74° W.	14.9	S. 84° W.	16.1	S. 84° W.	17.0
3,500	N. 70° W.	16.3	N. 68° W.	14.7	N. 72° W.	16.7	N. 73° W.	16.3	N. 89° W.	21.7	N. 89° W.	20.1
4,000	N. 57° W.	17.4	N. 65° W.	13.0	N. 70° W.	13.8	N. 81° W.	16.2				
4,500	N. 68° W.	20.7	N. 58° W.	18.2	W.	19.0	N. 81° W.	18.3				
5,000												

Altitude, m. s. l. (m.)	Ellendale, N. Dak. (444m.) Mean. Dir.	Vel.	6-year mean. Dir.	Vel.	Groesbeck, Tex. (141m.) Mean. Dir.	Vel.	5-year mean. Dir.	Vel.	Royal Center, Ind. (225m.) Mean. Dir.	Vel.	5-year mean. Dir.	Vel.
Surface	N. 71° W.	6.3	N. 48° W.	3.8	N. 40° E.	1.8	N. 38° W.	0.3	S. 80° W.	2.3	S. 81° W.	2.2
250					N. 61° E.	2.1	S. 84° W.	0.2	S. 86° W.	2.3	S. 79° W.	2.4
500	N. 72° W.	6.8	N. 51° W.	4.0	S. 74° E.	2.4	S. 30° W.	1.0	S. 86° W.	3.8	S. 67° W.	3.6
750	N. 71° W.	9.5	N. 56° W.	5.4	S. 46° E.	1.9	S. 40° W.	2.0	S. 88° W.	6.3	S. 70° W.	5.3
1,000	N. 67° W.	9.3	N. 53° W.	6.0	S. 7° W.	2.8	S. 57° W.	3.2	W.	9.4	S. 76° W.	6.8
1,250	N. 66° W.	10.5	N. 55° W.	7.0	S. 15° W.	3.6	S. 68° W.	4.3	N. 85° W.	10.0	S. 82° W.	8.2
1,500	N. 64° W.	11.2	N. 60° W.	8.3	S. 35° W.	4.3	S. 77° W.	5.5	N. 76° W.	11.1	S. 86° W.	9.6
2,000	N. 62° W.	13.5	N. 65° W.	10.4	S. 43° W.	5.6	S. 82° W.	7.7	N. 74° W.	12.6	N. 89° W.	11.1
2,500	N. 63° W.	15.1	N. 68° W.	12.7	S. 62° W.	5.1	S. 88° W.	8.9	N. 62° W.	16.8	N. 84° W.	13.5
3,000	N. 65° W.	17.2	N. 71° W.	14.2	S. 81° W.	9.1	S. 86° W.	11.5	N. 56° W.	16.8	N. 85° W.	14.5
3,500	N. 66° W.	15.5	N. 73° W.	13.3	S. 84° W.	11.3	S. 87° W.	12.9	N. 51° W.	18.8	N. 82° W.	18.0
4,000	N. 68° W.	18.4	N. 69° W.	14.0	S. 88° W.	12.8	N. 87° W.	13.4	N. 39° W.	18.0	N. 80° W.	18.3
4,500	N. 71° W.	19.0	N. 67° W.	14.7	N. 80° W.	15.6	N. 78° W.	15.0				
5,000	W.	24.8	S. 76° W.	20.2	N. 45° W.	16.2	N. 45° W.	16.2				

THE WEATHER ELEMENTS.

By P. C. DAY, Meteorologist, in Charge of Division.

PRESSURE AND WINDS.

The disturbed atmospheric conditions, so persistent during the first two months of the present winter, continued into February, although some reduction in the number of cyclones was noted, but anticyclones were numerous and frequently of marked strength.

The most important anticyclone of the month appeared in the far Canadian Northwest on the morning of the 12th, and during the following two days it gathered strength, moved southward, and by the morning of the 14th was central over the upper Missouri Valley where sea-level pressure was above 31 inches, the highest observed, 31.20 inches, being reported from Miles City, Mont. This anticyclone, gradually moving eastward and southeastward, dominated the weather in nearly all portions of the United States and Canada until near the end of the second decade. Severe cold was experienced in nearly all the States during that period, and cyclonic activity was greatly reduced, the storms usually entering the North Pacific States, and other sections being unable to penetrate the high pressure barriers.

The cyclones were usually not severe except during the 12th to 14th, when a low-pressure area passing over the Great Lakes and other northern districts, in conjunction with rapidly rising pressure to the westward caused heavy drifting snows, high winds, and severe blizzard conditions from Minnesota eastward to New York.

The pressure distribution for the month as a whole showed marked variations from the conditions usually expected in February. In the Canadian Northwest Provinces and the adjoining portions of the United States, the averages for the month were far above the normal. In fact, all sections of the United States and Canada, as far as the reports disclose, had averages above normal, a condition rarely experienced.

Also the changes in pressure from the preceding month, presented marked abnormalities. Usually the pressure for February is distinctly less than that for January, save for a few points in the Lake Superior district, where the change from winter to spring conditions is usually delayed by the heavy accumulations of snow and ice in that region, and along the immediate north Pacific coast, where the pressure usually does not begin to fall until March.

During February, just closed, the average pressure was higher than for the preceding month in all parts of the United States and Canada, save over the lower St. Lawrence Valley. In the western districts of both the United States and Canada the increases from January to February were everywhere unusually large.

The distribution of the average pressure, unusually high from the far Northwest southeasterly to the Gulf States, caused uniformly prevailing westerly winds to the northward of the ridge of highest pressure, and mainly northerly winds to the southward.

High winds prevailed over nearly all northern districts from the 12th to 14th, accompanying the most important barometric depression of the month. Some of the higher velocities noted were: 86 miles at Tatoosh Island, Wash.; 80, at Independence, Calif.; and 78, at Buffalo, N. Y. At Independence the velocity was most unusual, and covered an extensive area in the vicinity of that place. A full description of this storm with notes on damage appears on pages 82–83 of this issue.

Aside from high winds during the period indicated, there were few other winds of importance.

TEMPERATURE.

The unseasonable warmth which had continued during most of the two preceding months of the winter save over the Northeastern States terminated with the first few days of February, and the remainder of the month was distinctly cold, particularly until near the end of the second decade in the central and eastern districts and during nearly the entire month in the far Northwest.

The important cold periods were mainly during the early part of the first decade in the districts from the Mississippi Valley westward, except over the Northwest where the lowest temperatures frequently occurred on the 13th and 14th. East of the Mississippi Valley the 17th and 18th were decidedly cold, particularly in the Southeastern States, extending to the 19th at points in Florida. Over portions of the Ohio Valley and Middle Atlantic States the 24th was the coldest day of the month, while in the Northeastern States the 6th and 18th were the coldest days.

The warmest periods were the 1st and 2d over most of the Gulf and Atlantic Coast States; about the 12th and 13th from the Middle Plains eastward to the Ohio Valley and portions of the Middle Atlantic States; near the end of the second and the beginning of the third decade over much of the Rocky Mountains and Plateau regions; and in the far Northwest and over the Pacific Coast States on the 27th and 28th.

The first week was decidedly cold in the central Plateau region, the averages being from 15° to 20° or more below normal. The week was also colder than normal over all other districts of the country save from the central portions of Texas and Oklahoma eastward to the Atlantic coast. In the southern portions of this area the week was distinctly warm.

The second week of the month continued cold in all districts save over portions of the Gulf, and Middle and Southern Plains States, severe cold continuing generally in the central Plateau region. The third week was colder than normal over all portions of the country save the central and southern portions of the Rocky Mountain region, the southern portion of the Plateau and generally over California and Oregon. The week continued decidedly cold over all northern districts from Washington to New England. The final week of the month was mainly warmer than normal from the Mississippi Valley westward, but it continued cold to the eastward.

The month as a whole was colder than normal in nearly all parts of the country as shown by Chart III, at the back of this issue.

In the more Northeastern States and the Maritime Provinces of Canada, the month closed a period of cold that had continued the greater part of the winter, which, on account of the frequent and deep snow, the continued heavy snow cover and attending severe cold, may well be designated as an "old-fashioned winter." In the far Northwestern States the month was among the coldest, and in several States the coldest, of record for February.

Over a limited area from eastern South Dakota to southern Kansas, the month was slightly warmer than normal, and similar conditions existed, in portions of Georgia and Florida, along the Texas coast, generally over California, and over the Canadian Northwest.

PRECIPITATION.

To eastward of the Continental Divide the most important rainfalls of the month occurred about the 2d to 5th from the lower Mississippi Valley northeastward to the middle and southern Appalachians, and again over this region and as far as the Middle Atlantic coast districts about the 9th to 13th; in southern and southwestern Texas about the middle of the month; and from the 21st to 27th from west Texas eastward to the central portions of the Carolinas.

The rain first mentioned gave way to snow over the northern part of the area where the precipitation was heavy.

California had some light to moderate rains during the first 12 days, but virtually no precipitation afterward. The middle decade brought most of the precipitation that occurred in Oregon and Washington, the amounts being rather large over western Washington, where almost all portions had snow rather than rain.

The month's precipitation was less than normal over much more than half of the country. There was a considerable excess from southern New Mexico eastward over Texas and thence northeastward to the Ohio River and the Appalachian crest from Maryland to northern Georgia; and here the monthly amounts ranged from about 6 to 12 inches from south-central Texas to north-central Georgia. There was usually about the normal amount in the central and eastern portions of Colorado and Wyoming, and in North Dakota, northern Minnesota, and western Michigan.

Considerable deficiencies were noted in New England, near the coast to southward of Chesapeake Bay, especially over the Florida Peninsula, from Illinois westward and southwestward to the western borders of Nebraska, Kansas, and Oklahoma; and over most of the Plateau States, California, and western Oregon.

The scanty rainfall in Florida was very unfavorable, as drought prevailed over large portions of the State when the month began. In California the light precipitation during the month in most counties was considered unfortunate in its probable effects on the summer water supply. The central plains also were somewhat adversely affected by the February dryness.

SNOWFALL.

In the Northeast snowfall was not notably heavy, but owing to the low temperatures there was little melting at any time and deep snow cover remained.

About the 13th to 15th rather heavy snow from Minnesota to New York, continued with cold and high winds, caused great interference with traffic, several lives being lost in the North-Central States.

In the southern Middle Atlantic States, near the Ohio River, and especially in Missouri and Kansas there was decidedly little snow during February, and in Missouri and Kansas and near-by States the snowfall of the entire winter was the least of record.

Early in the month considerable snow for the latitude occurred from south-central Oklahoma to eastern Tennessee and the districts adjacent.

In the western half of the country the most notable snowstorm occurred in Washington and adjacent districts about the 11th to 14th. At lower levels the depths were generally from 12 to 20 inches, and there was much interference with traffic, especially around Spokane where the snow drifted greatly. In the Mountain districts of the far West the February snowfall was nearly everywhere less than normal, notably in Nevada and central and northern California. Somewhat more than normal occurred in Oregon and New Mexico.

The accumulated snowfall in the higher districts is, however, sufficient to promise a moderately good flow of water during the warmer season in all but a few districts.

RELATIVE HUMIDITY.

The relative amount of moisture in the atmosphere during the month was on the whole deficient, although in small areas it was distinctly in excess, among these were areas on the eastern slopes of the Rocky Mountains, from the lower Mississippi Valley westward to Arizona, and along the entire northern border, where there were many localities having percentages well above the normal.

In the middle plains the percentages were usually much less than normal, the deficiencies exceeding 20 per cent in some cases, and similar conditions existed over much of California.

SEVERE LOCAL STORMS, FEBRUARY, 1923.

[The table herewith contains such data as have been received concerning severe local storms that occured during the month. A more complete statement will appear in the Annual Report of the Chief of Bureau.]

Place.	Date.	Time.	Width of path (yards).	Loss of life.	Value of property destroyed.	Character of storms.	Remarks.	Authority.
Tunica and Tate Counties, Miss.	2					Wind	Fifteen persons injured; buildings blown down, and other property losses resulted.	Official, U. S. Weather Bureau.
Spokane, Wash	12					Blizzard	Street car service hampered; business interfered with. No other damage reported.	Do.
Independence, Calif., and vicinity	12					High winds	Much damage to ranch houses, power lines, and telegraph poles.	Do.
Michigan, Minnesota, and Wisconsin.	13-14					Cold waves and blizzards.	Traffic demoralized; some loss of life; much property damage and many cases of frozen hands and feet. Complete suspension of train service in western Minnesota.	Do. Do.
Bismarck, N. Dak	13-14					Blizzard	Train service interrupted; some branch lines not in operation for 7 days.	Do.
Baltimore, Md	14					High winds	Windows broken; trees uprooted; small house unroofed; telephone and telegraph poles down.	Do.
Seattle and Tacoma, Wash	14					Snow and ice	Wires broken; car service stopped; trains delayed; business interrupted.	Do.
Pittsburgh, Pa	14-15					High wind	Plate-glass windows and signs damaged; telegraph and telephone poles down; numerous fires caused partly by high winds.	Do.

STORMS AND WEATHER WARNINGS.

WASHINGTON FORECAST DISTRICT.

Storm warnings.—Storm warnings were issued for the Atlantic coast from the Virginia Capes northward on the 2d and 3d in connection with a disturbance of considerable intensity which moved rapidly east-northeastward over the Lake Region and northern New England. However, no winds of verifying velocity were reported.

The next warnings were issued for the coast from Cape Hatteras to Atlantic City at 10 a. m. of the 5th, at which time a disturbance was central over the eastern Gulf of Mexico and a strong high-pressure area was over the Lake Region and the Middle Atlantic States. These warnings were verified.

At 1 p. m. of the 12th pressure was quite high over northern New England and falling very rapidly over the Lake region and the Ohio Valley and southeast storm warnings were ordered displayed from the Virginia Capes to Eastport, Me. Verifying velocities were reached at a number of stations, the highest, 48 miles an hour from the southeast, occurring at Nantucket, Mass.

On the 14th pressure was abnormally high west of the Appalachian Mountains and low over New England, and northwest storm warnings were displayed from Cape Hatteras to Nantucket, Mass. The highest velocities reported were 72 miles an hour at New York City and 60 miles at Block Island, R. I., both from the northwest.

The last storm warnings of the month were orderd displayed at 10 p. m. of the 17th on the Atlantic coast

from Cape Hatteras to Atlantic City. A velocity of 48 miles was reported at Cape Henry, Va.

Cold-wave warnings.—The most important cold-wave warnings of the month were those isued on the 2d–3d and the 13th–14th. On the 2d they were issued for the Ohio Valley and western New York and on the 3d were extended over the remainder of the Washington Forecast District, except portions of the South Atlantic States. These warnings were fully verified, except from the southern portion of eastern Pennsylvania southward. The morning of the 13th cold-wave warnings were ordered for Ohio and western Kentucky, and in the evening were extended eastward to the Appalachian Mountains and southward over western Tennessee. The following morning warnings were issued for Vermont and the extreme northern portion of eastern Pennsylvania. These warnings were fully verified. During the remainder of the month cold-wave warnings were not needed, except for very limited areas on the 9th and 10th.

Frost warnings.—Frost warnings were issued for portions of the South Atlantic and East Gulf States on the following dates: 5th, 6th, 7th, 15th, 16th, 17th, 18th, 19th, 22d, and 23d. The most important were those of the 18th, when heavy to killing frost was predicted for Florida to the 27th parallel and light to heavy frost in the extreme southern portion. These warnings were well verified, as a rule.—*Charles L. Mitchell*.

CHICAGO FORECAST DISTRICT.

The month was cold over most of the forecast district, there being a few small areas, however, in which the temperature was above the normal. The temperature in the Great Lakes region, upper Mississippi and lower Ohio Valleys, and the northern Rocky Mountain district, ranged from 2° to 7° below the normal. Precipitation was deficient, with the exception of the Ohio Valley where a considerable fall occurred.

Two cold waves swept the entire forecast district, one during the first few days in the month and the other about the middle of the month.

The first appeared in northern Alberta on the night of February 1, but the report from Edmonton, the most northerly outpost, which gave evidence of its coming, was received too late. As a consequence of this fact and the rapid movement of the cold wave eastward across Montana and Wyoming, warnings were not issued in advance to those States, with the exception of live-stock warnings for southern Wyoming. Cold-wave warnings were issued, however, on the morning of the 2d for the balance of the trans-upper Mississippi region and extended in the afternoon and night across the Mississippi Valley to the eastern limits of the Chicago Forecast District; and live-stock warnings were extended to Kansas and Nebraska. These advices were fully verified at practically every station.

The second general cold wave appeared in the Canadian Northwest on the morning of the 12th and moved southward and eastward in the wake of a well-marked storm area, the cold in the Northwest steadily increasing in intensity while its influence extended over the entire forecast district by the morning of the 14th. Warnings of this cold wave were sent to every station in the forecast district, with a resulting complete verification. Live-stock warnings were, moreover, issued to the Dakotas, Nebraska, and Wyoming for strong winds, snow, and cold, and doubtless these were of considerable benefit to stockmen.

Both of these cold waves were brought in by strong winds, the second one reaching gale force quite generally over the North-Central States. Advices were sent to ports on Lake Michigan, which maintain winter navigation, well in advance of these severe winter conditions. No casualties were reported on the lake.

Another cold wave, but not of a general character, pushed down from Manitoba over the northern Plains States and upper Mississippi Valley on the 5th and 6th. Warnings were sent to the various States well in advance of the occurrence of critical temperatures.

From time to time during the month messages were sent to various points in the forecast district, and especially in the northwestern portion, in regard to a prospect for temperature conditions for several days in advance, sometimes for one week; and local interests in Chicago were kept in rather close touch with the weather office during the month in connection with shipments and work of varying character.

The forecasts of the ensuing night minimum temperatures in Chicago are now of the highest importance, and the actual minima during the entire month agreed closely with the predictions, with a few exceptions.—*H. J. Cox*.

NEW ORLEANS FORECAST DISTRICT.

Following the unseasonably warm weather experienced in the three preceding months, comparatively low temperatures prevailed during much of February prior to the 20th.

Cold-wave warnings for the northwestern portion of the district, issued on the night of January 31, were repeated on the morning of February 1 and extended over northern Arkansas, but failed of verification, as the area of high pressure on which they were based diminished in intensity.

An extensive area of high pressure appeared in western Canada on the morning of February 2 and cold-wave warnings were issued for the northern portion of west Texas. On special observations, the warnings were extended over Oklahoma and the northwestern portions of Arkansas and east Texas. Further extensions of the warnings were made, so that by the 3d the entire district was included. This cold wave was the most severe and the most general of the winter in this district; and the warnings, which were timely, were fully verified. It was attended by strong northerly winds to moderate gales on the West Gulf coast, for which warnings were displayed on the Texas coast from 8:30 p. m. of the 2d to 8:30 p. m. of the 4th and on the Louisiana coast from 12:30 p. m. of the 3d to 12:30 p. m. of the 4th. A warning of moderate northerly gales at Tampico, Mexico, was issued on the 3d, at noon.

A warning issued on the morning of the 10th, for a cold wave in the Texas Panhandle, was not verified.

Warnings were issued February 12–14 well in advance of a cold wave which overspread the interior portions of the district. While this cold wave was attended by higher pressure than that of the 3d–6th, the temperature was not generally so low; but the cold weather continued slightly longer.

Northeast storm warnings were ordered displayed on the Texas coast at 1:15 p. m. on the 14th and were justified.—*R. A. Dyke*.

DENVER FORECAST DISTRICT.

A marked anticyclonic area appeared over Alberta on the morning of the 2d, and cold-wave warnings were issued for eastern Colorado. The warnings were extended to the portion of New Mexico east of the mountains on the evening of the 2d and were repeated for southeastern New Mexico on the morning of the 3d. The warnings were verified, the fall in temperature in eastern Colorado ranging from 25° to more than 35° and was more than 30° at Roswell, where a temperature of 12° above zero was reported. An area of low pressure developed in Nevada on the 8th. By the morning of the 9th the center of the area had moved southeastward to Flagstaff and moderate cold-wave warnings were issued for northeastern and extreme northern Arizona and extreme southern Utah. Cold waves were confined to the area specified in the warnings.

Cold-wave warnings were issued on the morning of the 10th for extreme southwestern Colorado and northern New Mexico owing to the unusually low temperatures prevailing to the westward, although the low pressure area had decreased in intensity. The warnings were not officially verified.

Warnings of a severe cold wave were issued for eastern Colorado and a moderate cold wave for extreme northeastern New Mexico on the evening of the 12th. The warnings were repeated for eastern Colorado on the morning of the 13th and extended to the region east of the mountains in New Mexico. By the evening of the 13th the barometer in Alberta and parts of eastern Montana was 31 inches, and the warnings were repeated for the same areas. On the morning of the 14th, with a barometer reading of more than 31 inches in eastern Montana and temperatures ranging from 2° to more than 30° below zero in Montana and northern Wyoming, the warnings were continued for south-central Colorado and extended to eastern New Mexico. The warnings of the 12th and 13th for eastern Colorado were verified.—*Frederick W. Brist.*

SAN FRANCISCO FORECAST DISTRICT.

During most of the month high-pressure areas were dominant over eastern Alaska, British Columbia and the northern Rocky Mountain States. No severe storms originating over the ocean succeeded in breaking through this barrier.

Among the conditions little understood was the development of a LOW over Nevada on the morning of the 8th. Twenty-four hours earlier there was a small high-pressure area over Nevada and the fall in pressure amounted to 0.62 of an inch at Reno in 24 hours. One day later (February 9) a low-pressure area similarly developed over Alberta, where at Calgary the fall in pressure amounted to 0.52 of an inch in 24 hours. The development over Nevada caused good rains in southern California; and the one over Alberta after moving westward[1] (a very unusual direction) hovered off the North Pacific coast for a couple of days and then moved southeastward, causing snow in the Northern States and rain in northern California. The forecasting of both of these storms was unusually difficult because of their developing practically right in the district and their eventual movements were very problematical, especially the one forming over Alberta, which during its early history moved westward then south along the coast, then north to Vancouver Island, from where it moved southeastward and eventually reached the St. Lawrence Valley on the 15th; but it lost greatly in energy after crossing the Rocky Mountains. It was this storm when it was central in eastern Oregon on the 12th that caused the heavy blow in the Owens River Valley, upon which a special report has been made by the official in charge of the Independence, Calif., station. The winds were also heavy on that day in Nevada, where the damage is estimated at about $350,000.

Another freak storm appeared off the Washington coast on the morning of the 13th. When the observations were taken at 5 a. m. that morning, no storm was in evidence, but in a very short while snow began falling in western Washington and western Oregon. This proved to be the worst storm of the season in those States. This storm was well defined the next morning, the 14th, and on account of its size and strength there was a strong likelihood of its breaking through the high-pressure barrier to the east; but instead of doing so, it retreated westward and remained in the Gulf of Alaska for five days, when having greatly diminished in energy it moved eastward to Alberta and later advanced to the St. Lawrence Valley.

Heavy frosts occurred frequently in California during the first half of the month and it was necessary to issue warnings on no less than 12 days. Two cold-wave warnings were ordered, only one being verified. Storm warnings were displayed for one or more stations on 9 days, for the most part being verified.—*E. A. Beals.*

[1] More complete reports might show that the westward movement was more apparent than real.—EDITOR.

RIVERS AND FLOODS.

By H. C. FRANKENFIELD, Meteorologist.

During the closing days of January, 1923, heavy rains fell over the drainage area of the Ohio River and the southern tributaries rose to moderate flood heights during the early days of February. The Ohio River was already in flood in the Evansville (Ind.) district, as was also the upper Green River, and the additional water from above accentuated and prolonged the rises and extended the flood conditions almost to the mouth of the Ohio River, the crest stage at Cairo having been 43.8 feet, 1.2 feet below flood stage, on February 13. The river was in flood from Cloverport, Ky., to Shawneetown, Ill., with crests about 7 feet above flood stage and passed below the flood stage at the latter point on February 15. Green River crests were from 8 to 10 feet above flood stage and it was not until February 21 that the river at Lock No. 2, Rumsey, Ky., fell below the flood stage of 34 feet.

Nearly similar conditions prevailed in the Cumberland and Tennessee Rivers and their tributaries, except that the crest stages were not so much above the flood stage. The usual rise followed in the lower Mississippi River, but without flood stages except at New Madrid, Mo., where the river rose to 34.3 feet, 0.3 foot above flood stage on February 15.

Warnings of these floods were issued promptly and losses were inconsiderable. Along the Cumberland River the reported losses totaled only $4,300. There was no other loss of consequence, and a large amount of livestock, logs, lumber, and crossties was removed from places of danger.

The early rains of the month also caused floods in the smaller southern rivers, beginning with the White River of Arkansas and the Sulphur River of northeast Texas.

The White River flood was quite pronounced, but the

timely warnings prevented any damage of consequence. Reported losses were only $4,500, against which $25,000 worth of property was saved through the warnings. The flood in the Ouachita River of Arkansas was unimportant. It was well forecast, no losses of consequence occurred, and all cattle were removed from the bottoms.

East of the Mississippi River and south of Tennessee all rivers were also in flood early in the month, except the Alabama and tributaries, which, however, rose to flood stage about the middle of the month, following the heavy rains of February 12 and 13. The floods in the Tombigbee and Black Warrior Rivers of Alabama were more pronounced, the crest stages ranging from 9 to 16 feet above flood stage.

With but a single exception these floods were properly forecast and the total of reported losses was only $7,600, while the value of property saved was $11,500. It should be stated, however, that the floods occurred during a season of the year when not much property is exposed to damage from ordinary flood.

There were moderate floods in the lower Sabine and lower Trinity Rivers of Texas about the middle of the month. They were well forecast and no damage was reported. The upper Sabine River was in flood and rising at the close of the month.

The Guadalupe and Nueces Rivers of Texas were also in moderate flood from February 23 to 25, inclusive, without damage of consequence.

Flood stages during February, 1923.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
ATLANTIC DRAINAGE.					
Cape Fear:	*Feet.*			*Feet.*	
Elizabethtown, N. C	22	8	8	22.0	8
Santee:					
Rimini, S. C	12	2	2	12.5	2
Do	12	7	19	14.5	11
Do	12	28	[2]	12.0	28
Ferguson, S. C	12	[1]	4	12.3	1
Do	12	8	25	13.5	12-13
Broad:					
Blairs, S. C	15	28	[2]	15.2	28
Saluda:					
Chappels, S. C	14	28	[2]	16.2	28
Oconee:					
Milledgeville, Ga	22	14	14	23.7	14
Do	22	28	[2]	24.0	28
Ocmulgee:					
Abbeville, Ga	11	[1]	1	11.3	1
Do	11	20	23	11.8	21-22
EAST GULF DRAINAGE.					
Apalachicola:					
Blountstown, Fla	15	8	22	18.7	17
Alabama:					
Montgomery, Ala	35	16	16	35.3	16
Selma, Ala	35	17	18	36.2	17-18
Cahaba:					
Centerville, Ala	25	13	14	30.0	13
Tombigbee:					
Lock No. 4, Ala	39	[1]	3	45.1	1
Do	39	8	25	54.8	20
Black Warrior:					
Lock No. 10, Ala	46	14	16	55.4	14
Pearl:					
Jackson, Miss	20	[1]	1	20.5	1
Do	20	4	23	30.7	16
Columbia, Miss	18	13	[2]	20.6	28
West Pearl:					
Pearl River, La	13	13	[2]	15.0	27-28
MISSISSIPPI DRAINAGE.					
Ohio:					
Cloverport, Ky	40	3	9	43.9	6
Evansville, Ind	35	[1]	13	42.2	7-8
Henderson, Ky	33	[1]	13	40.2	8-9
Dam No. 48, Ind	42	1	13	48.7	9
Mount Vernon, Ind	35	2	14	41.3	9
Shawneetown, Ill	35	2	15	42.3	9
Little Kanawha:					
Glenville, W. Va	23	2	2	23.8	2
Elk:					
Clay, W. Va	18	2	2	19.6	2
Big Sandy:					
Pikeville, Ky	35	3	3	39.0	3

Flood stages during February, 1923—Continued.

River and station.	Flood stage.	Above flood stages—dates.		Crest.	
		From—	To—	Stage.	Date.
MISSISSIPPI DRAINAGE—continued.					
Kentucky:	*Feet.*			*Feet.*	
Beattyville, Ky	30	3	4	36.5	4
Green:					
Lock No. 6, Ky	30	3	7	38.4	5
Lock No. 4, Ky	33	[1]	10	44.7	6
Lock No. 2, Ky	34	[1]	21	42.4	10-11
Cumberland:					
Carthage, Tenn	40	5	8	43.0	6
Nashville, Tenn	40	4	11	43.5	9
Clarksville, Tenn	46	3	12	48.6	5
Tennessee:					
Knoxville, Tenn	12	4	6	16.8	5
Do	12	14	15	13.9	15
Rockwood, Tenn	20	6	6	21.4	6
Florence, Ala	18	9	11	18.2	11
Riverton, Ala	32	3	19	37.5	11
Holston:					
Rogersville, Tenn	14	4	4	17.0	4
North Fork:					
Mendota, Va	8	3	4	16.0	3
Do	8	13	14	10.0	13
Clinch:					
Speers Ferry, Va	20	3	4	22.0	3
Clinton, Tenn	25	4	6	32.2	5
Mississippi:					
New Madrid, Mo	34	11	15	34.3	13-14
St. Francis:					
Marked Tree, Ark	17	4	[2]	19.2	16-19
Petit Jean:					
Danville, Ark	20	4	5	21.5	4
Do	20	27	[2]	21.8	28
White:					
Calico Rock, Ark	18	2	4	27.3	2
Batesville, Ark	23	2	6	32.4	3
Newport, Ark	26	4	8	29.5	5
Georgetown, Ark	22	5	17	25.0	9-10
Black:					
Black Rock, Ark	14	[1]	18	21.7	4
Cache:					
Patterson, Ark	9	[1]	20	10.8	3-4
Tallahatchie:					
Swan Lake, Miss	25	9	[2]	28.4	16-18
Sulphur:					
Ringo Crossing, Tex	20	[1]	1	21.2	1
Finley, Tex	24	5	9	24.7	7
Ouachita:					
Camden, Ark	30	3	11	35.1	7
WEST GULF DRAINAGE.					
Sabine:					
Logansport, La	25	27	[2]	26.0	28
Bon Wier, Tex	20	13	15	20.3	14
Trinity:					
Liberty, Tex	25	13	15	25.4	14
Guadalupe:					
Gonzales, Tex	22	23	23	25.2	23
Victoria, Tex	16	25	25	18.2	25
Nueces:					
Three Rivers, Tex	37	23	25	41.6	24

[1] Continued from January.
[2] Continued into March.

MEAN LAKE LEVELS DURING FEBRUARY, 1923.

By UNITED STATES LAKE SURVEY.

[Detroit, Mich., March 7, 1923.]

The following data are reported in the "Notice to Mariners" of the above date:

Data.	Lakes.[1]			
	Superior.	Michigan and Huron.	Erie.	Ontario.
Mean level during February, 1923:	*Feet.*	*Feet.*	*Feet.*	*Feet.*
Above mean sea level at New York	601.60	578.81	570.88	244.47
Above or below—				
Mean stage of January, 1923	−0.26	−0.21	−0.29	−0.03
Mean stage of February, 1922	+0.22	−0.41	−0.29	−0.23
Average stage for February, last 10 years	−0.30	−1.18	−0.77	−1.05
Highest recorded February stage	−0.88	−3.91	−2.87	−2.20
Lowest recorded February stage	+0.84	−0.35	+0.25	+0.64
Average relation of the February level to—				
January level		0.00	−0.10	0.00
March level		−0.10	−0.10	−0.20

[1] Lake St. Clair's level: In February, 573.07 feet.

EFFECT OF WEATHER ON CROPS AND FARMING OPERATIONS: FEBRUARY, 1923.

By J. B. KINCER, Meteorologist.

Most of the month of February, 1923, was cold, disagreeable, and unfavorable for outdoor operations. The temperature averaged below normal in all sections of the country, except in a few local areas, principally in the Florida Peninsula. Rainfall was heavy in the Southern States, except along the immediate Gulf coast and in Florida there was considerable interruption to farm work because of wet soil. Sunshine was markedly deficient in the west Gulf section where only one-fourth to one-third of the possible amount was received during the month, but there was a high percentage of sunshine from the Great Plains westward, except in the extreme northwest.

A severe cold wave overspread central, southern, and eastern districts, except in Florida, on the 3d–5th. It was especially cold in west Gulf districts, some damage resulting to tender truck crops in that section. On the 14th and 15th, a second widespread cold wave was experienced in the southeast, with frost damage to vegetables and berries in the southern portions of Georgia, Mississippi, and Alabama and quite extensive damage to strawberries in northern Florida. Temperature conditions during the last week of the month were more favorable, especially in Central and Northwestern States, while copious and beneficial rains fell in the Southwest, which were particularly helpful in northwestern Texas and eastern New Mexico.

Wheat was somewhat damaged in parts of the Ohio Valley by the freeze about the middle of the month, particularly that late sown in Kentucky, but otherwise the cold weather apparently did little harm to that crop. Severe drought continued in the western portions of the Plains States, particularly in western Kansas and Oklahoma, and in Nebraska, where wheat suffered from lack of moisture. Otherwise moisture was generally sufficient for this crop. Not much oat seeding was done in the east Gulf States because of unfavorable weather, but this work progressed favorably in the southern Great Plains.

There was considerable unfavorable weather for stock in the Western and Northwestern States, but no serious loss was reported. Heavy feeding was necessary in much of the Northwest. There was sufficient precipitation during the latter part of the month to cause a material improvement in the ranges in northwestern Texas and eastern New Mexico where moisture had been deficient, but more moisture was needed in the western Great Plains. Stock were reported in generally good condition in Central and Eastern States. A storm on the 25th gave much-needed moisture in the eastern portions of Wyoming which was of especial benefit to sheep, while the weather during the latter part of the month was favorable for lambing in California and Oregon.

CLIMATOLOGICAL TABLES.[1]

CONDENSED CLIMATOLOGICAL SUMMARY.

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation, by sections, February, 1923.

Section.	Temperature.								Precipitation.					
	Section average.	Departure from the normal.	Monthly extremes.						Section average.	Departure from the normal.	Greatest monthly.		Least monthly.	
			Station.	Highest.	Date.	Station.	Lowest.	Date.			Station.	Amount.	Station.	Amount.
	°F.	°F.		°F.			°F.		In.	In.		In.		In
Alabama	47.8	+0.1	2 stations	83	13	Valley Head	10	17	5.93	+0.52	Talladega	10.72	Citronelle	2.52
Arizona	45.1	−1.7	3 stations	88	[2] 17	Flagstaff	−14	10	0.99	−0.29	Crown King	6.70	3 stations	0.00
Arkansas	41.9	−0.3	2 stations	80	[2] 1	Nail	5	4	4.66	+1.38	Grannis	8.21	Bentonville	1.66
California	47.5	−1.0	Santa Rosa	93	28	Sierraville	−16	9	1.23	−3.03	Inskip	6.06	3 stations	0.00
Colorado	24.3	−2.4	Canon City	70	19	Fraser	−45	4	0.81	−0.22	Longs Peak	2.60	2 stations	T.
Florida	62.2	+2.0	Ritta	90	13	Garniers	15	19	1.63	−1.63	Garniers	6.34	Key West	0.06
Georgia	49.4	+1.5	Bainbridge	86	1	Clayton	0	17	4.81	−0.16	Monticello	8.51	Savannah	0.93
Hawaii	68.0	−0.2	3 stations	86	[2] 6	Glenwood	39	7	7.92	+1.04	Kalihi Valley	21.10	Holualoa	0.68
Idaho	22.4	−4.9	Orofino	63	28	Alpha	−32	1	0.67	−0.96	Soldier Creek	2.62	Parma	0.02
Illinois	25.9	−1.8	Harrisburg	65	13	2 stations	−15	14	1.43	−0.65	Harrisburg	4.53	Oregon	0.21
Indiana	26.6	−2.6	Rome	64	13	Laporte	−11	4	2.15	−0.50	Mount Vernon	6.11	Collegeville	0.75
Iowa	20.1	−0.4	Clarinda	61	24	2 stations	−23	[2] 3	0.40	−0.75	Columbus Junction	1.71	2 stations	0.00
Kansas	31.5	−0.9	3 stations	68	12	Norton	−8	3	0.19	−0.94	Columbus	1.16	3 stations	0.00
Kentucky	34.6	−1.0	Williamsburg	74	13	Anchorage	−4	18	4.67	+1.07	Junction City	7.50	Scott	2.56
Louisiana	53.9	+1.0	2 stations	85	[2] 1	Minden	16	[2] 4	5.63	+0.99	2 stations	10.72	Delta Farms	1.02
Maryland-Delaware	30.7	−1.7	Westernport, Md	70	13	Oakland, Md	−9	24	2.81	−0.27	Oakland, Md	4.60	Chesapeake City, Md.	2.10
Michigan	15.1	−3.2	Bergland	47	25	Humboldt	−46	5	1.27	−0.40	2 stations	3.50	Johannesburg	0.21
Minnesota	6.2	−4.3	Grand Rapids	60	25	Itasca State Park	−47	3	0.59	−0.22	Morris	2.25	2 stations	T.
Mississippi	47.5	−0.9	3 stations	83	[2] 2	University	10	5	6.43	+1.51	Fayette	11.71	Bay St. Louis	3.42
Missouri	30.2	−1.2	Caruthersville	75	13	Conception (2)	−9	3	1.37	−0.88	Patton	4.80	Oregon	0.10
Montana	17.1	−4.2	Roy	64	27	Babb	−46	14	0.58	−0.16	Adel	4.42	2 stations	T.
Nebraska	24.7	−0.1	2 stations	65	[2] 23	Nenzel	−22	3	0.18	−0 54	Alliance	0.80	.....do	0.00
Nevada	29.0	−5.2	Las Vegas	78	[2] 16	Millett	−26	10	0.26	−0.73	Owyhee	0.73	7 stations	0.00
New England	15.5	−6.4	Turners Falls, Mass.	53	2	3 stations	−38	[2] 18	1.66	−1.64	Chestnut Hill, Mass.	3.13	Northfield, Vt	0.47
New Jersey	26.1	−3.6	Indian Mills	56	9	Culvers Lake	−12	8	2.58	−1.03	Tuckerton	3.74	Sussex	1.51
New Mexico	35.3	−1.7	Lakewood (near)	74	27	Red River Canyon	−17	4	1.15	+0.34	Pearl (near)	3.25	2 stations	0.04
New York	17.8	−3.8	Cutchogue	51	1	Indian Lake	−34	6	1.83	−1.00	Scarsdale	3.81	Lauterbrunnen	0.36
North Carolina	41.0	−0.8	2 stations	79	2	2 stations	−1	[2] 18	3.29	−0.62	Andrews	7.48	Wilmington	1.41
North Dakota	4.1	−3.8	Hansboro	48	[2] 24	.....do	−40	3	0.65	+0.16	2 stations	2.10	Berthold Agency	T.
Ohio	26.4	−1.8	Ironton	69	13	Millport	−7	24	2.01	−0.55	Dam No. 28	5.10	North Bass Island	0.73
Oklahoma	39.4	−0.3	2 stations	74	[2] 1	Kenton	−10	4	1.11	−0.47	Antlers	6.20	Kingfisher	T.
Oregon	33.1	−3.1	Bend	76	28	Harney Branch Experiment Station.	−26	1	1.41	−2.03	Classic Lake	5.41	2 stations	T.
Pennsylvania	24.6	−2.7	2 stations	58	3	Saegerstown	−20	24	2.16	−0.70	Elk Lick	4.80	Montrose	0.65
Porto Rico	72.6	−0.9	Lares	93	10	Aibonito	45	18	2.18	−0.60	Dorado	4.75	Portola	0.00
South Carolina	44.8	−2.3	2 stations	82	2	Walhalla	11	[2] 18	3.83	−0.58	Calhoun Falls	6.25	Paris Island	0.70
South Dakota	16.4	−0.4	Hermosa	63	24	Newell	−32	13	0.24	−0.39	Harveys Ranch	1.40	3 stations	0.00
Tennessee	38.9	−1.6	Coldwater	75	13	Crossville	0	18	4.64	+0.43	Henderson	6.92	Kenton	3.19
Texas	49.1	−1.2	Mission	93	10	2 stations	−4	4	4.50	+2.70	Harlingen	12.10	Canadian	0.35
Utah	23.7	−6.5	Springdale	71	19	Pineview	−25	3	0.68	−0.59	Pinto	2.92	3 stations	T.
Virginia	35.5	−0.9	2 stations	72	[2] 2	Burkes Garden	−1	[2] 18	3.01	−0.26	Marion	5.85	Arcola	0.78
Washington	29.3	−5.1	Grapeview	66	24	Republic	−27	13	1.84	−1.41	Forks	9.00	2 stations	0.14
West Virginia	30.4	−1.5	Hinton	70	13	Cheat Bridge	−20	24	3.68	+0.70	Pickens	7.38	Upper Tract	0.75
Wisconsin	10.5	−4.9	Prairie du Chien	52	25	Long Lake	−43	5	0.70	−0.42	Manitowoc	1.45	Salon Springs	0.10
Wyoming	17.2	−4.2	Quaking Aspen Creek.	72	21	Riverside	−42	9	0.70	−0.19	2 stations	2.15	Powell	0.01

[1] For description of tables and charts, see REVIEW, July, 1922, pp. 384-385.

[2] Other dates also.

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TABLE 1.—*Climatological data for Weather Bureau stations, February 1923.*

Districts and stations.	Elevation of instruments: Barometer above sea level.	Thermometer above ground.	Anemometer above ground.	Pressure: Station, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Temperature of the air: Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation: Total.	Departure from normal.	Days with .01, or more.	Wind: Total movement.	Prevailing direction.	Maximum velocity: Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow, sleet and ice on ground at end of month.
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0-10	In.	In.
New England.							**19.2**	**−6.2**										**72**	**1.58**	**−1.8**										**6.0**		
Eastport	76	67	85	29.93	30.02	+.04	13.7	−7.8	35	9	22	−9	4	6	31	12	6	71	2.36	−1.3	10	8,126	w.	40	ne.	13	9	5	14	5.8	23.6	31.0
Greenville, Me	1,070	6		28.80	30.03		7.3		33	3	18	−22	4	−4	45				2.15		6		se.				18	3	7		21.5	26.0
Portland, Me	103	82	117	29.95	30.08	+.06	16.9	−6.9	37	3	25	−8	17	9	31	14	8	71	1.87	−1.8	10	5,475	nw.	36	nw.	3	9	7	12	5.5	15.6	39.1
Concord	288	70	79	29.75	30.08	+.04	16.4	−6.4	39	3	26	−14	18	7	45				1.03	−2.2	6	3,784	nw.	25	w.	14	12	11	5	4.0	13.5	22.7
Burlington	404	11	48	29.62	30.10	+.07	11.6	−6.3	38	9	21	−18	4	2	41				0.48	−0.9	9	7,181	s.	44	s.	3	3	10	15	7.5	6.6	10.8
Northfield	876	12	60	29.09	30.10	+.06	10.3	−6.9	40	2	22	−22	4	−2	51	8	4	83	0.47	−1.8	7	5,014	s.	30	sw.	9	4	10	14	7.0	8.0	23.1
Boston	125	115	188	29.93	30.08	+.04	23.4	−5.4	45	3	30	2	17	17	23	20	11	58	1.48	−2.0	10	7,443	w.	35	w.	14	8	10	10	5.8	14.3	5.8
Nantucket	12	14	90	30.04	30.05	+.04	25.8	−6.8	44	3	31	8	24	20	20	24	20	79	2.25	−0.9	13	9,751	nw.	48	se.	13	8	4	16	6.2	12.7	0.9
Block Island	26	11	46	30.04	30.07	+.01	25.4	−5.0	43	3	31	7	24	20	21	23	20	79	1.85	−2.4	13	13,756	nw.	60	nw.	14	7	7	14	6.2	9.8	3.0
Providence	160	215	251	29.90	30.09	+.04	22.7	−6.3	42	1	30	2	19	16	24	20	14	69	1.97	−2.4	12	9,008	nw.	53	nw.	3	6	11	11	5.8	16.3	4.4
Hartford	159	122	140	29.92	30.10	+.04	21.8	−5.4	43	1	30	1	18	14	32	19	13	69	1.62	−1.9	13	4,842	nw.	26	nw.	16	7	11	10	6.1	13.1	14.9
New Haven	106	74	153	29.99	30.12	+.05	23.5	−5.5	43	27	30	4	18	17	29	20	15	72	1.97	−1.8	12	5,992	nw.	35	se.	13	10	8	10	5.6	16.8	3.5
Middle Atlantic States.							**30.0**	**−3.4**										**72**	**2.41**	**−0.8**										**6.2**		
Albany	97	102	115	30.02	30.13	+.06	18.8	−5.3	40	3	27	−1	24	10	35	17	14	80	1.24	−1.3	12	5,213	s.	28	s.	3	14	8	6	4.3	9.6	8.5
Binghamton	871	10	84	29.12	30.09	+.01	20.4	−4.3	45	13	29	2	18	12	33				1.57	−0.3	17	4,769	nw.	30	nw.	14	2	7	19	7.8	13.7	4.0
New York	314	414	451	29.77	30.12	+.04	27.1	−4.2	46	27	34	7	18	20	22	24	17	65	2.33	−1.4	14	11,565	nw.	70	nw.	14	3	13	12	7.0	17.4	0.2
Harrisburg	374	94	104	29.74	30.16	+.07	27.0	−2.9	46	25	33	7	18	21	25	24	18	70	1.84	−0.9	13	5,133	nw.	38	w.	13	4	10	14	6.9	10.4	T.
Philadelphia	114	123	190	30.02	30.16	+.06	30.0	−3.9	51	25	36	10	24	24	28	27	21	69	2.71	−0.7	13	7,191	nw.	34	nw.	15	3	8	14	7.1	8.2	0.0
Reading	325	81	98	29.77	30.14		26.8		46	25	33	8	18	20	29	24	20	76	2.38	−1.1	17	5,058	nw.	36	nw.	15	8	6	14	6.0	12.8	T.
Scranton	805	111	119	29.23	30.13	+.05	23.0	−3.9	47	13	31	4	24	15	30	21	16	76	1.58	−1.1	17	4,970	sw.	42	sw.	14	3	11	14	6.9	11.4	3.5
Atlantic City	52	37	172	30.08	30.13	+.03	30.2	−3.4	54	3	36	8	24	24	25	27	23	76	3.17	−0.1	12	11,137	nw.	50	nw.	14	10	5	13	6.0	7.4	0.0
Cape May	18	13	49	30.15	30.17	+.06	30.8	−3.3	52	3	36	11	24	25	21	28	24	78	2.92	−0.4	11	6,099	nw.	36	nw.	15	11	4	13	5.8	11.5	0.0
Sandy Hook	22	10	55	30.10	30.12		26.4		42	9	32	8	18	21	20	24	19	73	2.30		13	10,921	w.	64	w.	14	3	11	14	6.9	9.6	0.2
Trenton	190	159	183	29.92	30.13		26.4		46	9	33	7	24	20	26	24	18	71	2.68	−0.5	12	8,058	nw.	52	nw.	14	6	8	14	6.9	14.1	0.0
Baltimore	123	100	113	30.02	30.16	+.05	32.4	−3.0	54	28	39	12	18	26	24	28	21	68	2.51	−1.0	11	4,271	n.	34	w.	14	6	9	13	6.4	4.3	0.0
Washington	112	62	85	30.03	30.16	+.05	32.6	−2.7	58	13	40	11	18	26	26	28	22	68	2.19	−1.2	12	5,480	nw.	42	w.	14	8	7	13	6.0	3.9	0.0
Lynchburg	681	153	188	29.40	30.17	+.06	37.8	−2.5	69	2	47	14	18	29	31	32	26	69	2.38	−1.1	8	5,726	nw.	44	nw.	15	10	7	11	5.4	5.1	0.0
Norfolk	91	170	205	30.06	30.17	+.06	39.2	−3.5	68	3	47	19	16	32	28	35	29	72	2.01	−1.7	12	9,351	ne.	40	nw.	15	8	7	13	5.8	2.0	0.0
Richmond	144	11	52	30.00	30.17	+.06	37.0	−2.9	65	2	45	15	17	29	24	32	27	74	3.09	0.0	11	5,881	nw.	36	nw.	15	12	4	12	5.4	5.0	0.0
Wytheville	2,304	49	55	27.70	30.18	+.06	33.1	−2.0	60	13	41	7	18	26	33	29	23	73	3.90	−0.2	13	5,675	w.	40	nw.	14	10	6	12	5.4	7.1	0.0
South Atlantic States.							**46.7**	**−1.6**										**74**	**2.66**	**−1.2**										**5.6**		
Asheville	2,255	70	84	27.76	30.20	+.07	38.3	−0.2	72	2	47	6	18	30	30	33	27	71	2.06	−1.2	9	7,256	nw.	36	nw.	14	11	7	10	5.5	0.2	0.0
Charlotte	779	55	62	29.31	30.18	+.06	42.2	−1.7	74	2	51	18	18	34	28	36	29	66	4.25	−0.1	10	4,202	sw.	22	nw.	15	10	2	16	6.1	0.2	0.0
Hatteras	11	12	11	30.13	30.14	+.03	43.9	−3.5	68	2	50	25	16	38	24	41	39	85	2.61	−1.9	9	10,704	sw.	42	nw.	18	12	5	11	5.5	T.	0.0
Manteo	12	5	42				41.0		77	3		18	17		34				3.26		5		nw.				15	4	9		0.0	0.0
Raleigh	376	103	110	29.76	30.17	+.06	40.8	−2.5	70	2	49	18	16	32	30	36	30	71	4.78	+0.4	10	6,050	sw.	36	nw.	14	8	5	15	6.1	0.1	0.0
Wilmington	78	81	91	30.10	30.19	+.07	45.8	−2.1	76	2	54	22	16	37	31	41	37	78	1.41	−2.0	7	5,002	w.	26	sw.	27	12	6	10	5.4	T.	0.0
Charleston	48	11	92	30.13	30.18	+.06	50.3	−2.1	76	27	58	28	19	43	27	44	40	74	1.03	−2.4	7	7,272	sw.	29	s.	27	10	7	11	5.5	0.0	0.0
Columbia, S. C.	351	41	57	29.81	30.20	+.09	46.3	−1.5	77	2	55	21	19	37	30	40	33	69	2.83	−1.8	10	4,973	ne.	29	w.	20	11	3	14	6.0	0.0	0.0
Due West	711	10	55	29.42	30.22		43.7		75	2	53	17	19	34	32				5.74		10	6,047	sw.	30	w.	1	10	6	12	5.7	T.	0.0
Greenville, S. C.	1,039	113	122	29.04	30.16		43.2		73	2	52	16	18	34	27	37	31	71	4.62		11	5,922	sw.	31	n.	18	10	5	13	5.6	T.	0.0
Augusta	180	62	77	29.99	30.18	+.06	48.2	−1.7	77	2	57	23	19	34	39	43	40	78	4.78	+0.4	10	3,833	nw.	25	w.	1	10	5	13	5.8	0.0	0.0
Savannah	65	150	194	30.12	30.19	+.07	52.9	−1.1	80	3	62	27	19	44	26	46	41	72	0.93	−2.4	6	8,512	nw.	38	sw.	13	11	5	12	5.0	0.0	0.0
Jacksonville	43	209	245	30.14	30.20	+.08	58.0	0.0	81	10	67	30	19	49	27	51	47	76	1.93	−1.5	4	8,159	sw.	38	sw.	13	11	10	7	4.4	0.0	0.0
Florida Peninsula.							**68.7**	**+1.5**										**77**	**0.30**	**−2.3**										**4.1**		
Key West	22	10	64	30.12	30.14	+0.7	72.8	+2.3	83	6	77	56	19	68	14	68	66	86	0.06	−1.6	1	6,735	se.	24	e.	24	17	7	4	3.4	0.0	0.0
Miami	25	71	79	30.15	30.18		69.8	+1.0	82	6	76	44	19	64	25	63	60	74	0.24	−2.5	3	5,271	se.	23	e.	26	13	9	6	4.8	0.0	0.0
Sand Key	23	39	72	30.13	30.16	+.09	71.4		78	10	74	58	19	69	8	67	64	77	0.24		4	10,299	ne.	36	e.	24	15	10	3	3.4	0.0	0.0
Tampa	35	79	87	30.15	30.19	+.09	63.6	+1.3	83	14	72	35	19	55	25	56	51	72	0.61	−2.7	3	3,914	n.	23	s.	5	8	14	6	4.9	0.0	0.0
East Gulf States.							**50.2**	**−1.0**										**75**	**5.60**	**+0.8**										**5.8**		
Atlanta	1,174	190	216	28.92	30.19	+.07	43.7	−1.6	72	13	51	13	18	36	30	40	35	76	7.47	+2.8	12	9,277	nw.	42	nw.	18	12	3	13	5.5	0.0	0.0
Macon	370	78	87	29.80	30.20	+.08	49.0	+0.1	78	3	58	20	18	40	32	43	36	69	4.43	−0.2	10	5,275	nw.	30	nw.	18	10	3	15	5.9	0.0	0.0
Thomasville	273	49	58	29.90	30.20	+.08	55.6	+0.6	80	13	65	25	19	46	32	50	45	77	3.35	−1.1	8	3,661	sw.	20	sw.	13	9	6	13	5.8	0.0	0.0
Apalachicola	36	42	49	30.16	30.20		57.0		75	13	64	31	19	50	25	52	49	81	2.64		6	5,456	n.	27	ne.	23	8	11	9	5.4	0.0	0.0
Pensacola	56	149	185	30.14	30.21	+.10	54.4	−0.8	72	1	61	29	19	48	23	50	47	79	4.95	+0.5	8	9,331	ne.	47	nw.	26	9	6	13	5.6	0.0	0.0
Anniston	741	9	57	29.43	30.24	+.12	45.2	−0.6	77	13	54	15	19	37	32				7.70	+3.0	12	4,653	n.	23	nw.	17	11	5	12	5.4	0.0	0.0
Birmingham	700	11	48	29.46	30.25	+.13	45.8	−2.5	79	13	55	15	18	37	32	40	33	69	5.87	+1.1	12	5,232	n.	24	s.	13	12	4	12	5.3	T.	0.0
Mobile	57	125	161	30.14	30.21	+.10	53.6	−1.6	79	13	62	28	19	46	25	48	44	77	4.58	−0.8	9	7,559	n.	33	n.	3	6	8	14	6.2	0.0	0.0
Montgomery	223	100	112	29.98	30.23	+.11	50.8	−0.8	80	13	59	20	18	42	30	45	39	69	6.79	+1.3	9	4,920	n.	28	n.	18	13	3	12	5.2	0.0	0.0
Corinth	469	6					41.8		72	13	51	15	18	33	36				4.52		11		n.				7	10	11		6.0	0.0
Meridian	375	85	93	29.82	30.23	+.11	48.6	−0.5	80	13	58	20	18	39	33	43	37	71	7.13	+2.2	10	4,459	n.	22	s.	2	10	9	9	5.4	0.0	0.0
Vicksburg	247	65	73	29.96	30.25	+.15	48.6	−3.2	77	13	56	22	4	41	35	44	39	77	6.97	+2.4	9	5,121	ne.	23	ne.	23	7	4	17	6.8	6.0	0.0
New Orleans	53	76	84	30.14	30.20	+.11	57.0	−0.3	82	13	65	34	6	49	28	51	48	77	2.33	−2.1	7	5,237	ne.	22	n.	3	6	9	13	6.5	0.0	0.0
West Gulf States.							**48.6**	**−1.2**										**79**	**4.16**	**+1.4**										**7.3**		
Shreveport	249	77	93	29.96	30.24	+.15	48.4	−1.6	81	1	56	21	4	41	32	44	40	77	6.21	+2.6	12	5,084	ne.	28	ne.	4	9	4	15	6.5	3.1	0.0
Bentonville	1,303	11	44				35.8	−2.7	60	1	45	8	4	26	28				1.66		10						11	4	13		3.0	0.0
Fort Smith	457	79	94	29.74	30.24	+.14	40.6	−1.2	70	1	48	17	4	33	33	36	29	68	1.77	−1.0	7	5,417	e.	42	w.	2	7	7	14	6.6	1.2	0.0
Little Rock	357	136	144	29.85	30.24	+.13	42.4	−2.5	72	1	50	18	4	35	34	38	33	73	6.42	+2.2	10	5,489	n.	34	w.	28	8	6	14	6.4	3.1	0.0
Brownsville	57	4	26	30.04	30.10		62.5		83	13	70	31	5	55	39	58	57	89	7.64		15	6,956	s.	37	s.	2	3	9	16	7.3	T.	0.0
Corpus Christi	20	11	73	30.12	30.14	+.09	57.7	0.0	79	1	63	29	5	52	33	54	52	86	2.61	+0.6	15	9,676	ne.	48	s.	9	1	3	24	8.9	T.	0.0
Dallas	512	109	117	29.66	30.22		46.1		73	1	54	18	4	38	36				1.99		13	5,253	nw.	25	n.	4	7	2	19	6.9	2.4	0.0
Fort Worth	670	106	114	29.48	30.21	+.14	46.4	−1.7	76	12	56	18	4	37	33	41	36	73	2.05	+0.8	12	5,832	n.	29	s.	8	6	4	18	7.1	T.	0.0
Galveston	54	106	114	30.12	30.18	+.11	56.3	0.0	76	13	61	29	5	51	26	53	51	86	5.09	+2.0	9	8,940	se.	41	n.	4	4	6	18	7.5	0.0	0.0
Groesbeck	461	11	56	29.70	30.19		47.7		78	1	55	17	6	40	29				4.09		16	7,090	n.	39	n.	4	7	0	21	7.4	3.5	0.0
Houston	138	111	121	30.02	30.17		56.5	+2.5	80	1	64	27	5	49	31				4.03		13	6,167	n.	31	s.	25	5	9	14	6.9	T.	0.0
Palestine	510	64	72	29.66	30.21	+.13	49.4	−1.8	79	1	57	23	4	42	27	45	40	75	3.71	+0.3	14	5,517	ne.	28	ne.	4	5	2	21	7.6	T.	0.0
Port Arthur	34	58	66	30.13	30.17		55.4		80	13	62	28	5	49	28	51	48	80	6.21		7	7,359	ne.	38	ne.	4	5	6	17	7.4	0.0	0.0
San Antonio	701	119	132	29.42	30.16	+.11	52.0	−2.4	82	1	60	24	6	44	30	48	45	81	5.47	+3.7	18	5,769	ne.	38	n.	3	3	4	21	8.0	1.0	0.0
Taylor	582	55	63	29.58	30.20	+.14	49.2	−2.1	80	1	57	18	6	42	31				4.08	+1.5	17	5,897	n.	33	n.	4	5	3	20	7.8	2.4	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, February, 1923*—Continued.

Districts and stations.	Elevation of instruments: Barometer above sea level.	Elevation of instruments: Thermometer above ground.	Elevation of instruments: Anemometer above ground.	Pressure: Station, reduced to mean of 24 hours.	Pressure: Sea level, reduced to mean of 24 hours.	Pressure: Departure from normal.	Temperature of the air: Mean max. + mean min. ÷ 2.	Temperature of the air: Departure from normal.	Temperature of the air: Maximum.	Temperature of the air: Date.	Temperature of the air: Mean maximum.	Temperature of the air: Minimum.	Temperature of the air: Date.	Temperature of the air: Mean minimum.	Temperature of the air: Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation: Total.	Precipitation: Departure from normal.	Precipitation: Days with 0.01, or more.	Wind: Total movement.	Wind: Prevailing direction.	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction.	Wind: Maximum velocity: Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow, sleet and ice on ground at end of month.
Ohio Valley and Tennessee.	Ft.	Ft.	Ft.	In.	In.	In.	°F. 32.3	°F. −3.6	°F.		°F.	°F.		°F.	°F.	°F.	°F.	% 74	In. 3.40	In. −0.2		Miles.								0–10 6.9	In.	In.
Chattanooga	762	189	213	29.40	30.23	+.10	42.1	−2.0	74	13	50	12	18	34	37	36	29	64	5.52	+0.6	14	6,329	nw.	34	nw.	17	10	5	13	5.6	1.0	0.0
Knoxville	996	102	111	29.13	30.21	+.09	39.4	−2.5	71	13	47	8	18	31	29	35	29	71	4.80	−0.1	13	5,004	sw.	28	sw.	13	9	3	16	6.8	9.5	0.0
Memphis	399	76	97	29.82	30.26	+.15	41.0	−3.3	70	1	48	16	18	34	37	37	31	71	4.61	+0.3	10	6,239	n.	36	nw.	13	11	2	15	5.9	4.6	0.0
Nashville	546	168	191	29.65	30.26	+.14	38.5	−3.1	69	13	47	12	18	30	41	34	28	70	4.36	0.0	11	7,240	nw.	49	nw.	13	10	4	14	6.0	5.7	0.0
Lexington	989	193	230	29.14	30.25	+.14	31.6	−4.0	63	13	39	2	18	24	41				4.40	+1.2	9	9,791	sw.	50	sw.	13	6	7	15	6.6	1.9	0.0
Louisville	525	219	255	29.65	30.25	+.14	32.4	−4.8	61	13	40	7	18	25	31	.....	.....	.....	3.65	−0.1	10	8,622	w.	46	w.	13	6	8	14	6.7	0.8	0.0
Evansville	431	139	175	29.78	30.26	+.15	32.6	−3.2	61	13	40	7	4	25	30	29	23	69	4.45	+1.4	9	8,125	n.	46	nw.	13	7	9	12	6.1	0.5	0.0
Indianapolis	822	194	230	29.30	30.23	+.13	26.0	−5.0	50	1	33	0	4	19	29	29	23	70	1.70	−1.4	10	9,088	nw.	54	w.	14	6	3	19	7.5	5.3	0.0
Royal Center	736	11	55	29.37	30.21	......	22.0		42	1	29	−5	4	15	30	24	19	76	1.30		13	7,986	w.	47	w.	13	4	6	18	7.6	4.9	0.0
Terre Haute	575	96	129	29.60	30.24	......	27.2	......	51	13	34	0	4	20	21	.....	.....	.....	1.32	......	9	7,366	nw.	39	w.	13	6	7	15	6.8	4.1	0.0
Cincinnati	628	11	51	29.52	30.22	+.12	28.3	−4.5	58	13	36	1	18	20	30	24	20	76	1.81	−1.4	11	6,090	sw.	38	w.	14	5	7	16	7.1	3.6	0.0
Columbus	824	179	222	29.28	30.19	+.10	26.4	−4.3	55	2	34	−1	18	19	31	.....	25	84	2.51	−0.6	12	8,514	nw.	61	nw.	14	5	4	19	7.5	9.0	0.0
Dayton	899	181	216	29.20	30.20	......	26.6	−3.4	57	1	34	1	18	19	31	24	19	75	1.60	−1.5	13	8,328	nw.	46	nw.	14	6	8	14	6.8	4.9	0.0
Elkins	1,947	59	67	28.04	30.20	+.10	29.2	−2.3	65	13	37	−7	24	21	48	25	21	78	3.73	+0.6	18	4,950	w.	40	w.	14	2	6	20	8.0	9.6	0.0
Parkersburg	638	77	84	29.53	30.22	+.12	31.2	−2.7	62	13	39	2	18	24	33	26	23	83	2.32	−0.9	13	4,956	nw.	38	nw.	14	4	7	17	7.5	6.0	0.0
Pittsburgh	842	353	410	29.23	30.18	+.09	27.4	−4.9	56	3	35	1	18	20	36	27	23	75	2.18	−0.5	15	8,723	nw.	62	w.	14	1	6	21	8.2	12.1	T.
Lower Lake Region.							**20.7**	**−4.3**										**78**	**1.46**	**−1.0**										**7.4**		
Buffalo	767	247	280	29.25	30.12	+.06	20.7	−3.6	41	2	27	0	24	14	35	19	15	80	1.24	−1.6	16	13,263	w.	78	w.	14	3	9	16	7.4	8.4	0.2
Canton	448	10	61	29.58	30.10	......	9.2	−8.8	39	8	20	−32	4	−1	43				1.67	−0.9	11	6,623	w.	49	w.	14	11	11	6	4.9	15.4	12.5
Oswego	335	76	91	......	30.11	+.05	18.4	−5.5	42	8	26	−6	4	11	34	.....	.....	.....	1.75	−0.7	20	8,019	s.	42	w.	14	0	6	22	....	39.2	0.5
Rochester	523	86	102	29.53	30.13	+.07	20.9	−3.7	43	8	28	−1	24	14	35	18	13	72	1.67	−1.2	19	7,324	w.	44	w.	14	3	6	19	7.9	17.5	10.0
Syracuse	597	97	113	29.45	30.12	+.05	19.6	−4.2	42	3	27	−3	4	12	37	.....	.....	.....	1.89	+0.1	21	8,002	nw.	51	w.	14	0	10	18	8.0	18.4	5.0
Erie	714	130	166	29.34	30.14	+.07	22.6	−4.3	47	2	30	−1	24	16	36	20	16	77	1.45	−1.4	14	9,950	w.	64	w.	14	2	13	13	7.1	5.5	0.0
Cleveland	762	190	201	29.31	30.17	+.10	23.8	−3.6	48	2	30	4	18	17	31	21	17	79	1.39	−1.2	18	9,564	w.	60	w.	14	0	8	20	8.5	8.9	0.0
Sandusky	629	62	70	29.47	30.18	+.11	24.4	−3.0	46	2	31	4	18	18	29	.....	.....	.....	1.21	−1.2	18	6,411	w.	44	nw.	14	0	10	18	8.1	3.4	0.0
Toledo	628	208	243	29.47	30.18	+.11	23.4	−3.9	44	1	30	4	18	17	31	21	17	76	1.16	−0.8	16	10,103	w.	61	w.	14	5	7	16	7.2	3.5	T.
Fort Wayne	856	113	124	29.23	30.20	......	23.0	−2.8	44	25	30	1	4	16	26	21	18	82	1.23	......	16	7,247	w.	48	w.	14	2	8	18	7.8	5.7	0.0
Detroit	730	218	258	29.34	30.17	+.11	21.6	−3.7	44	26	28	0	4	15	29	19	16	80	1.39	−0.8	17	8,452	nw.	51	w.	14	5	10	13	6.6	9.0	0.2
Upper Lake Region.							**14.5**	**−4.9**										**82**	**1.11**	**−0.6**										**6.5**		
Alpena	609	13	92	29.42	30.12	+.09	14.2	−3.8	37	26	23	−10	4	6	34	13	10	85	0.75	−1.0	15	8,069	w.	40	w.	14	6	10	12	6.1	7.3	1.8
Escanaba	612	54	60	29.44	30.15	+.09	9.9	−5.4	36	25	19	−21	4	0	31	9	6	87	0.99	−0.4	7	6,257	nw.	32	nw.	14	11	10	7	4.8	11.8	7.0
Grand Haven	632	54	89	29.44	30.16	+.11	19.5	−4.7	39	25	26	2	4	13	30	19	17	86	1.95	0.0	19	9,629	w.	56	w.	13	2	6	20	8.4	20.5	T.
Grand Rapids	707	70	87	29.36	30.16	+.11	19.6	−5.9	40	25	26	0	4	13	28	19	15	80	0.99	−0.9	16	4,801	w.	36	w.	13	6	6	16	7.0	13.2	T.
Houghton	684	62	99	29.36	30.13	+.08	9.0	−7.0	34	25	17	−19	5	1	37	.....	.....	.....	1.74	0.0	12	7,970	w.	63	w.	14	2	9	17	7.9	19.7	13.2
Lansing	878	11	62	29.16	30.14	......	17.7	−3.9	40	25	26	−3	3	9	35	17	14	86	1.01	−1.0	21	4,803	nw.	29	nw.	14	5	6	17	7.4	11.0	0.1
Ludington	637	60	66	29.42	30.14	......	18.0	......	41	25	24	−3	14	12	25	17	14	83	1.05	......	19	8,851	w.	47	w.	14	1	11	16	7.8	13.1	2.0
Marquette	734	77	111	29.30	30.15	+.10	12.4	−3.5	40	27	21	−18	4	4	28	10	6	80	1.21	−0.5	13	6,729	w.	40	sw.	24	5	8	15	6.9	12.3	13.5
Port Huron	638	70	120	29.42	30.15	+.10	18.8	−3.9	42	26	26	−4	4	12	34	17	14	85	1.14	−1.0	15	8,376	nw.	54	nw.	14	3	15	10	6.3	9.0	2.2
Saginaw	641	69	77	29.42	30.15	......	17.2	......	40	25	25	−4	4	10	33	16	12	82	0.74	−1.3	10	6,213	nw.	31	w.	8	6	6	16	7.0	4.9	1.6
Sault Sainte Marie	614	11	52	29.39	30.14	+.11	8.8	−4.6	34	26	18	−21	5	−1	34	8	5	86	1.00	−0.4	16	5,671	se.	43	nw.	8	8	5	15	6.4	10.0	17.0
Chicago	823	140	310	29.27	30.20	+.12	22.3	−5.1	44	26	29	−8	4	16	28	21	14	67	1.05	−1.1	11	8,129	w.	46	w.	14	8	5	15	6.2	8.0	T.
Green Bay	617	109	144	29.45	30.16	+.10	11.9	−5.3	41	25	21	−19	4	3	31	11	7	80	0.91	−0.7	10	8,270	sw.	52	sw.	14	7	13	8	6.2	11.1	2.5
Milwaukee	681	125	139	29.40	30.18	+.09	18.6	−4.2	43	25	26	−12	4	11	29	16	11	71	1.17	−0.7	9	7,345	w.	36	se.	12	8	11	9	5.5	10.2	T.
Duluth	1,133	11	47	28.87	30.17	+.09	5.4	−6.0	37	26	15	−33	3	−5	38	4	2	90	0.92	−0.1	6	10,375	w.	64	w.	13	14	9	5	4.2	10.0	8.0
North Dakota.							**4.9**	**−2.8**										**86**	**0.60**	**0.0**										**5.9**		
Moorhead	940	50	58	29.16	30.24	+.13	4.8	−3.3	35	7	15	−24	3	−5	47	4	1	85	0.45	−0.3	8	6,740	nw.	37	nw.	13	8	5	15	6.1	5.9	5.9
Bismarck	1,674	8	57	28.40	30.31	+.19	7.4	−2.9	45	28	18	−28	4	−3	42	6	4	88	0.46	0.0	3	7,599	nw.	42	w.	13	9	10	9	5.2	4.9	2.0
Devils Lake	1,482	11	44	28.54	30.23	+.12	2.0	−2.5	36	28	12	−30	3	−8	36	0	−2	87	0.73	+0.2	10	8,944	nw.	46	nw.	13	11	7	10	5.3	9.7	4.8
Ellendale	1,457	10	56	28.60	30.26	......	7.4	......	38	28	17	−23	4	−2	40				0.47	......	6	11,927	nw.	62	nw.	13	8	7	13	6.3	4.7	0.7
Grand Forks	835	12	89	......	......	......	4.1	......	38	25	16	−31	3	−8	40	.....	.....	.....	0.76	......	8	......	w.	48	nw.	7	17	4	7	....	7.6	9.5
Williston	1,878	41	48	28.17	30.28	+.17	5.5	−2.6	42	28	18	−30	14	−7	50	4	2	86	0.76	+0.3	11	6,411	w.	38	nw.	7	6	9	13	6.4	10.4	T.
Upper Mississippi Valley.							**21.6**	**−3.5**										**75**	**0.78**	**−0.9**										**5.8**		
Minneapolis	918	102	208	29.17	30.21	......	10.3	......	43	25	19	−25	3	1	42	.....	.....	.....	0.41	−0.3	5	9,010	nw.	46	nw.	13	7	11	10	5.9	4.2	0.5
St. Paul	837	236	261	29.27	30.23	+.14	9.8	−6.0	44	25	20	−25	3	0	49	.....	.....	.....	0.50	−0.3	5	9,634	w.	60	sw.	13	7	17	4	4.7	6.4	T.
La Crosse	714	11	48	29.40	30.22	+.14	12.8	−6.4	50	25	23	−22	3	2	32	.....	.....	.....	0.70	−0.4	8	3,973	nw.	24	w.	14	6	8	14	6.3	9.0	T.
Madison	974	70	78	29.10	30.22	+.15	15.0	−4.1	41	25	23	−18	3	6	30	13	10	81	0.93	−0.5	8	7,050	nw.	33	w.	13	7	7	14	6.4	10.5	T.
Wausau	1,247	4	....	28.76	30.18	......	8.2	......	40	25	18	−26	3	−2	32	.....	.....	.....	0.85	......	9	......	nw.	......	......		12	3	13	5.4	17.4	8.0
Charles City	1,015	10	49	29.10	30.24	+.14	14.4	−0.7	52	25	24	−19	3	4	43	12	12	85	0.41	−0.6	4	5,684	nw.	30	nw.	14	7	10	11	5.8	5.0	T.
Davenport	606	71	79	29.55	30.25	+.15	21.2	−3.7	50	24	30	−10	3	13	29	19	15	76	0.64	−0.9	5	5,587	nw.	32	w.	13	9	7	12	5.9	6.1	0.0
Des Moines	861	84	97	29.29	30.25	+.14	22.4	−1.3	55	25	32	−8	3	13	37	19	13	68	0.36	−0.7	7	5,663	nw.	32	nw.	13	9	12	7	4.8	2.7	0.0
Dubuque	698	81	96	29.45	30.25	+.16	18.3	−3.9	49	25	27	−16	3	10	28	16	11	73	0.40	−1.0	4	5,370	nw.	30	nw.	13	5	10	13	6.7	4.8	T.
Keokuk	614	64	78	29.56	30.28	+.17	25.1	−3.2	52	25	34	−6	3	17	30	22	16	67	0.35	−1.3	4	5,987	nw.	42	w.	13	9	7	12	5.9	0.8	0.0
Cairo	358	87	93	29.86	30.26	+.14	34.8	−3.2	65	13	42	9	4	27	32	30	24	69	2.57	−0.8	9	7,238	n.	39	nw.	17	8	5	15	6.4	1.2	0.0
Peoria	609	11	45	29.56	30.26	+.16	23.2	−2.7	45	24	31	−6	4	15	31	21	18	82	0.83	−1.9	10	5,446	nw.	30	w.	13	11	4	13	6.0	1.5	0.0
Springfield, Ill.	644	10	91	29.53	30.24	+.14	26.2	−3.3	48	1	33	−3	4	19	28	24	20	79	0.79	−2.0	9	6,467	nw.	32	w.	13	9	7	12	5.8	1.6	0.0
Hannibal	534	74	109	29.65	30.25	+.14	27.0	−2.7	49	21	35	−2	3	19	28	.....	.....	.....	0.53	−1.1	6	6,372	nw.	32	nw.	13	9	8	11	5.7	0.7	0.0
St. Louis	567	265	303	29.63	30.26	+.15	30.4	−4.1	54	13	38	1	4	23	28	26	20	69	1.50	−1.2	10	8,368	nw.	44	w.	13	8	7	13	6.0	5.1	0.0
Missouri Valley.							**25.1**	**−0.1**										**68**	**0.34**	**−0.7**										**4.7**		
Columbia, Mo.	781	11	84	29.38	30.26	+.15	28.9	−1.2	52	25	37	1	4	21	27	.....	.....	.....	1.00	−1.1	9	5,855	nw.	36	nw.	13	9	7	12	5.7	1.3	0.0
Kansas City	963	161	181	29.19	30.27	+.16	30.2	+0.3	62	12	39	0	3	21	30	25	16	59	0.36	−1.2	4	8,019	nw.	48	nw.	13	11	10	7	4.5	1.2	0.0
St. Joseph	967	11	49	29.18	30.25	......	28.8	......	56	12	38	−4	3	20	34	24	16	63	0.20	......	4	6,155	nw.	42	nw.	13	12	8	8	4.4	0.6	0.0
Springfield, Mo.	1,324	98	104	28.80	30.26	+.15	32.0	−1.6	55	12	40	4	4	24	26	28	23	75	1.27	−1.0	5	6,904	n.	35	nw.	13	12	5	11	5.2	4.3	0.0
Iola	984	11	50	29.18	30.27	+.17	32.2	+0.2	63	12	42	4	4	22	32	.....	.....	.....	0.43	−0.7	5	5,396	n.	30	nw.	13	11	9	8	5.1	0.2	0.0
Topeka	987	92	107	......	......	......	30.4	+0.4	62	12	40	−3	3	20	36	.....	.....	.....	0.24	−1.1	4	7,247	n.	44	n.	2	10	12	6	4.2	1.2	0.0
Drexel	1,299	10	54	28.81	30.26	......	23.2	......	53	24	35	−11	3	12	43	.....	.....	.....	0.09	......	4	7,623	n.	36	sw.	7	10	11	7	5.1	0.8	0.0
Lincoln	1,189	11	84	......	......	......	26.4	+1.6	57	24	38	−5	3	15	41	.....	.....	62	0.07	−0.6	2	7,455	n.	43	n.	2	11	7	10	....	0.7	0.0
Omaha	1,105	115	122	29.04	30.28	+.17	25.6	+0.1	54	5	35	−8	3	16	37	21	14	66	0.08	−0.7	4	6,681	nw.	40	nw.	2	13	6	9	4.6	0.1	0.0
Valentine	2,598	47	54	27.43	30.28	+.19	21.2	−0.2	63	23	35	−10	3	8	54	17	14	73	0.10	−0.5	3	6,450	nw.	34	s.	11	10	17	1	4.3	1.4	0.0
Sioux City	1,135	94	164	29.00	30.28	+.16	21.0	0.0	55	25	32	−11	3	10	39	17	9	65	0.08	−0.5	3	9,145	nw.	55	nw.	13	13	10	5	3.9	0.8	0.0
Huron	1,306	59	74	28.83	30.32	+.20	14.9	+0.6	49	24	26	−19	3	4	40	11	8	82	0.05	−0.4	5	7,493	nw.	48	w.	13	14	6	8	4.1	0.4	0.0
Pierre	1,572	70	75	28.54	30.30	+.19	18.7	+1.0	56	24	30	−14	14	4	44	15	10	74	0.04	−0.4	3	7,003	nw.	52	nw.	13	13	5	10	4.7	0.4	0.0
Yankton	1,233	49	57	28.90	30.30	+.18	19.6	−1.2	53	27	32	−14	3	8	39	.....	.....	.....	0.06	−0.5	2	7,332	nw.	36	nw.	13	9	14	5	4.8	0.8	0.0

TABLE 1.—*Climatological data for Weather Bureau stations, February, 1923*—Continued.

Districts and stations.	Elevation of instruments. Barometer above sea level.	Thermometer above ground.	Anemometer above ground.	Pressure. Station, reduced to mean of 24 hours.	Sea level, reduced to mean of 24 hours.	Departure from normal.	Temperature of the air. Mean max. + mean min. ÷ 2.	Departure from normal.	Maximum.	Date.	Mean maximum.	Minimum.	Date.	Mean minimum.	Greatest daily range.	Mean wet thermometer.	Mean temperature of the dew point.	Mean relative humidity.	Precipitation. Total.	Departure from normal.	Days with 0.01, or more.	Wind. Total movement.	Prevailing direction.	Maximum velocity. Miles per hour.	Direction.	Date.	Clear days.	Partly cloudy days.	Cloudy days.	Average cloudiness, tenths.	Total snowfall.	Snow, sleet and ice on ground at end of month.
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles.								0–10	In.	In.
Northern Slope.							**18.7**	**−3.1**										**72**	**0.45**	**−0.3**										**5.7**		
Billings	3,140	5	.....	.....	.....	.....	21.2	.....	58	23	34	−20	14	9	45	.....	.....	.....	0.40	.....	6	.....	nw.	.....	.....	.....	10	5	13	.....	7.7	0.0
Havre	2,505	11	44	27.54	30.34	+.27	13.6	0.0	55	28	24	−32	14	3	43	12	9	85	0.32	−0.2	8	5,701	sw.	36	n.	1	[illegible]	14	9	5.8	3.2	0.0
Helena	4,110	87	112	25.93	30.34	+.23	18.0	−5.0	53	28	27	−23	13	9	30	15	11	78	0.49	−0.2	11	4,244	sw.	46	sw.	4	0	10	18	8.4	7.0	0.0
Kalispell	2,973	48	56	27.12	30.34	+.26	17.0	−6.8	45	24	25	−16	13	9	26	16	13	82	0.94	−0.5	9	2,735	nw.	21	ne.	12	6	8	14	6.8	8.9	1.0
Miles City	2,371	48	55	27.66	30.35	+.26	17.7	+0.9	62	28	29	−22	14	6	38	14	9	69	0.11	−0.4	4	4,653	nw.	36	se.	9	7	8	13	6.0	1.6	0.0
Rapid City	3,259	50	58	26.71	30.31	+.23	20.9	−2.6	61	24	34	−17	14	8	47	17	10	63	0.14	−0.3	4	5,442	n.	38	n.	2	8	13	7	5.1	1.4	0.0
Cheyenne	6,088	84	101	24.00	30.22	+.19	23.9	−3.4	57	18	36	−6	3	12	39	19	12	64	0.57	0.0	8	8,902	w.	60	w.	12	9	9	10	5.1	6.8	T.
Lander	5,372	60	68	24.70	30.32	+.24	14.6	−7.2	47	28	27	−21	3	2	42	12	6	70	0.77	+0.1	5	2,327	sw.	48	w.	12	15	8	5	4.2	8.1	1.0
Sheridan	3,790	10	47	26.21	30.32	.....	18.0	.....	57	[illegible]	31	−24	14	5	46	14	9	70	0.59	.....	6	3,405	nw.	34	nw.	2	9	9	10	5.8	6.4	T.
Yellowstone Park	6,200	11	48	23.91	30.31	+.21	16.4	−3.2	46	22	29	−22	14	4	50	13	9	74	0.59	−1.2	14	4,936	s.	52	nw.	12	10	8	10	5.5	6.7	17.3
North Platte	2,821	11	51	27.23	30.29	+.22	26.2	−0.4	61	23	41	−7	14	11	46	19	12	64	0.14	−0.3	3	4,706	n.	35	nw.	13	12	7	9	4.7	2.2	0.0
Middle Slope.							**31.9**	**−1.1**										**60**	**0.41**	**−0.4**										**4.9**		
Denver	5,292	106	113	24.76	30.20	+.19	28.2	−4.5	64	18	40	−8	3	17	45	23	16	65	1.09	+0.6	10	5,033	s.	32	n.	26	12	10	6	4.5	13.8	T.
Pueblo	4,685	80	86	25.35	30.19	+.19	29.6	−2.2	68	18	44	−6	4	15	53	24	16	62	0.76	+0.3	7	3,562	se.	35	w.	2	10	12	6	4.9	8.6	T.
Concordia	1,392	50	58	28.75	30.28	+.19	30.0	+1.2	59	24	41	−3	3	19	37	24	14	55	0.38	−0.4	4	5,704	n.	38	nw.	13	14	6	8	4.1	1.8	0.0
Dodge City	2,509	11	51	27.57	30.27	+.21	32.0	−1.2	61	24	45	−2	3	19	46	25	16	58	0.03	−0.7	2	6,671	ne.	36	s.	11	12	11	5	4.1	0.2	0.0
Wichita	1,358	139	158	28.76	30.25	+.17	33.6	+0.6	62	12	43	3	3	24	33	27	15	51	T.	−1.1	0	8,859	s.	48	nw.	13	15	6	7	4.1	T.	0.0
Broken Arrow	765	11	52	29.41	30.26	.....	36.6	.....	65	12	45	11	4	28	29	.....	.....	.....	0.70	.....	7	8,561	n.	42	n.	2	5	8	15	6.5	2.5	0.0
Muskogee	652	4	.....	.....	.....	.....	39.2	.....	65	12	49	13	4	30	34	.....	.....	.....	1.58	.....	7	.....	w.	.....	.....	.....	10	8	10	.....	4.5	0.0
Oklahoma City	1,214	10	47	28.93	30.26	+.19	38.0	−0.5	68	12	47	11	4	29	31	32	25	66	0.20	−0.8	5	7,769	n.	40	n.	2	7	10	11	5.9	1.0	0.0
Southern Slope.							**43.7**	**−0.8**										**70**	**1.98**	**+1.1**										**6.3**		
Abilene	1,738	10	52	28.35	30.21	+.16	44.6	−0.2	75	12	54	17	4	36	32	39	34	75	2.67	+1.6	10	6,235	s.	31	ne.	3	6	5	17	7.2	2.6	0.0
Amarillo	3,676	10	49	26.36	30.19	+.17	36.3	−0.9	62	12	48	3	3	25	36	31	26	72	1.71	+0.8	8	7,116	n.	37	sw.	12	14	7	7	4.6	9.3	0.0
Del Rio	944	64	71	29.14	30.15	+.15	52.4	−1.2	79	2	60	24	4	44	35	.....	.....	.....	1.60	+0.7	13	5,385	se.	28	nw.	4	3	6	19	7.8	0.7	0.0
Roswell	3,566	75	85	26.45	30.13	+.15	41.4	−1.1	70	12	52	12	4	31	38	35	26	62	1.93	+1.4	8	5,407	s.	36	w.	12	10	7	11	5.6	8.4	0.0
Southern Plateau.							**43.5**	**−1.4**										**55**	**0.43**	**−0.2**										**3.2**		
El Paso	3,762	110	133	26.24	30.07	+.12	46.2	−2.7	73	20	56	18	4	36	33	38	29	57	1.41	+1.0	8	7,943	e.	40	e.	14	12	10	6	4.1	1.4	0.0
Santa Fe	7,013	38	53	23.22	30.09	+.11	32.2	−0.9	58	15	44	0	4	20	34	26	20	64	0.25	−0.6	3	4,155	e.	43	sw.	12	14	9	5	3.8	2.3	0.0
Flagstaff	[illegible],908	10	59	23.31	30.06	+.06	26.1	−4.7	54	19	40	−14	10	12	47	21	.....	70	1.80	.....	8	5,287	e.	56	e.	4	15	8	5	.....	23.6	T.
Phoenix	1,108	11	81	28.85	30.02	+.03	55.3	+0.9	82	19	68	30	6	42	38	45	35	55	0.46	−0.2	4	3,283	e.	25	w.	25	15	9	4	3.6	0.0	0.0
Yuma	141	9	54	29.89	30.04	+.04	58.4	−0.2	87	17	72	32	11	45	38	45	28	33	0.03	−0.6	1	4,523	n.	32	n.	4	20	6	2	2.2	0.0	0.0
Independence	3,957	9	41	26.06	30.15	+.09	42.8	−0.9	71	17	57	10	2	29	41	34	24	52	0.02	−0.8	1	5,826	nw.	80	sw.	12	21	6	1	2.2	T.	0.0
Middle Plateau.							**28.0**	**−5.2**										**68**	**0.42**	**−0.7**										**3.6**		
Reno	4,532	74	81	25.58	30.27	+.19	29.2	−6.4	61	23	43	−4	10	16	45	26	20	71	0.35	−1.4	2	2,804	w.	48	w.	12	17	9	2	2.7	4.9	T.
Tonopah	6,090	12	20	24.12	30.21	.....	30.1	.....	52	22	38	1	1	22	23	25	18	61	0.56	−0.2	2	5,045	w.	38	nw.	25	19	8	1	2.7	7.0	0.0
Winnemucca	4,344	18	56	25.75	30.28	+.19	27.7	−5.8	56	24	41	−10	3	15	44	24	18	70	0.13	−0.8	5	5,212	ne.	48	sw.	12	17	3	8	4.2	2.5	0.0
Modena	5,479	10	43	24.67	30.21	+.17	22.0	−9.6	49	24	36	−15	10	8	45	19	14	71	0.95	−0.2	5	5,806	w.	44	sw.	12	19	4	5	2.8	10.8	0.0
Salt Lake City	4,360	163	203	25.76	30.26	+.18	26.6	−7.2	44	24	33	4	3	20	20	24	20	75	0.35	−1.0	6	3,266	nw.	39	w.	12	12	6	10	5.1	7.7	0.0
Grand Junction	4,602	60	68	25.45	30.10	+.06	34.6	+3.1	58	22	46	12	4	23	31	28	21	61	0.19	−0.4	5	3,703	se.	38	sw.	12	16	4	8	4.2	1.5	0.0
Northern Plateau.							**27.2**	**−5.2**										**75**	**0.88**	**−0.5**										**5.8**		
Baker	3,471	48	53	26.60	30.31	+.19	26.0	−1.9	52	28	35	−4	1	17	25	24	20	79	0.53	−0.8	6	4,141	se.	28	s.	11	8	10	10	5.4	7.7	0.0
Boise	2,739	78	86	27.37	30.32	+.20	30.7	−4.1	56	28	40	4	1	22	25	28	21	64	0.21	−1.2	4	3,010	se.	26	w.	12	14	6	8	4.2	4.5	0.0
Lewiston	757	40	48	29.49	30.34	+.23	30.2	−6.0	62	28	38	9	16	22	32	.....	.....	.....	0.70	−0.6	10	1,639	e.	35	w.	12	5	9	14	7.0	4.8	0.0
Pocatello	4,477	60	68	25.59	30.30	+.20	22.7	−5.4	44	21	32	−8	1	13	28	20	16	73	0.44	−0.4	6	5,822	se.	36	s.	11	12	11	5	4.3	6.1	0.0
Spokane	1,929	101	110	28.20	30.34	+.25	24.0	−7.3	54	28	33	−9	13	15	31	23	20	83	1.63	−0.3	9	2,659	sw.	32	n.	12	3	5	20	7.7	17.3	0.4
Walla Walla	991	57	65	29.23	30.34	+.23	29.8	−6.6	59	28	36	4	14	23	28	27	23	76	1.80	+0.2	8	2,598	se.	30	ne.	8	8	6	14	6.5	16.1	0.0
North Pacific Coast Region.							**39.0**	**−2.6**										**81**	**3.44**	**−1.8**										**7.1**		
North Head	211	11	56	30.01	30.24	+.18	40.6	−1.5	58	20	45	25	13	36	21	39	36	82	4.41	−1.4	12	8,921	n.	68	nw.	12	9	5	14	6.2	3.4	0.0
Port Angeles	29	8	53	30.25	30.28	.....	37.0	.....	43	51	17	31	14	13	19	.....	.....	.....	2.76	−0.3	10	4,452	s.	40	ne.	11	6	3	19	7.4	29.8	0.0
Seattle	125	215	250	30.16	30.30	+.24	37.3	−3.2	55	28	43	15	13	32	23	35	31	77	2.72	−1.0	8	4,339	se.	40	nw.	12	3	8	17	7.7	17.4	0.0
Tacoma	213	113	120	30.05	30.29	+.23	36.8	−3.6	55	28	43	15	13	31	24	.....	.....	.....	3.23	−1.9	11	3,200	n.	39	n.	12	3	9	16	7.3	22.0	0.0
Tatoosh Island	86	9	57	30.14	30.24	+.24	40.0	−1.0	55	17	44	16	13	36	22	38	37	88	7.76	−1.0	13	11,873	e.	86	ne.	13	4	7	17	7.5	14.0	0.0
Yakima	1,071	5	.....	.....	.....	.....	29.8	.....	60	28	40	−1	15	19	37	.....	.....	.....	0.30	.....	7	.....	sw.	.....	.....	.....	12	4	12	.....	.....	.....
Medford	1,425	4	.....	.....	.....	.....	40.1	.....	72	28	54	16	9	27	44	.....	.....	.....	0.38	.....	1	.....	se.	.....	.....	.....	14	4	10	.....	0.5	0.0
Portland, Oreg.	153	68	106	30.12	30.28	+.20	37.4	−4.7	62	28	43	14	14	32	27	35	32	82	1.81	−3.9	12	3,651	nw.	27	nw.	12	7	4	17	7.2	13.3	0.0
Roseburg	510	9	57	29.70	30.26	+.16	41.8	−1.6	65	28	49	20	9	35	28	39	35	78	1.41	−3.2	9	1,779	nw.	18	n.	8	2	16	10	6.4	0.1	0.0
Middle Pacific Coast Region.							**49.7**	**0.0**										**68**	**0.66**	**−3.3**										**4.0**		
Eureka	62	73	89	30.14	30.21	+.10	45.7	−1.1	61	27	52	28	9	39	23	43	40	81	0.50	−6.5	5	4,197	n.	44	sw.	11	11	6	11	5.2	0.0	0.0
Point Reyes	490	7	18	29.58	30.10	.....	49.4	+0.2	67	28	54	35	1	45	17	.....	.....	.....	0.40	.....	3	11,027	nw.	65	nw.	8	12	9	7	4.7	0.0	0.0
Red Bluff	332	50	56	29.79	30.15	+.04	51.6	+2.2	82	28	64	27	2	40	34	43	32	52	0.72	−2.9	3	4,973	nw.	39	nw.	26	21	5	2	2.1	0.0	0.0
Sacramento	69	106	117	30.07	30.14	+.05	50.2	+0.1	74	27	60	29	2	40	28	46	40	70	0.30	−2.8	3	4,985	n.	33	s.	12	18	7	3	3.0	0.0	0.0
San Francisco	155	208	243	29.96	30.13	+.03	52.2	0.0	73	27	59	38	2	45	23	46	40	69	0.77	−2.9	3	4,840	w.	32	ne.	26	14	10	4	3.6	0.0	0.0
San Jose	141	12	110	29.99	30.15	.....	49.0	−1.6	76	27	60	26	2	38	36	.....	.....	.....	1.02	−1.5	3	3,424	nw.	25	nw.	3	11	5	12	5.2	T.	0.0
South Pacific Coast Region.							**53.6**	**+0.6**										**67**	**1.10**	**−1.4**										**3.7**		
Fresno	327	89	98	29.78	30.14	+.06	50.2	+1.0	72	28	61	29	2	39	31	45	40	70	0.74	−0.6	4	3,133	nw.	18	nw.	28	17	6	5	3.2	0.0	0.0
Los Angeles	338	159	191	29.72	30.08	+.02	56.6	+1.1	87	17	66	36	1	48	29	48	39	58	0.75	−2.2	4	3,981	e.	27	e.	1	17	8	3	3.1	0.0	0.0
San Diego	87	62	70	29.98	30.07	+.01	55.2	+0.1	79	18	63	38	3	47	29	49	44	72	1.53	−0.4	7	3,823	nw.	26	s.	11	11	6	11	4.8	0.0	0.0
San Luis Obispo	201	32	40	29.90	30.12	+.01	52.6	+0.1	82	18	65	28	10	40	41	45	38	67	1.36	−2.2	5	2,415	n.	20	ne.	16	13	11	4	3.8	0.0	0.0
West Indies.																																
San Juan, P. R.	82	9	54	30.00	30.09	.....	73.7	−1.2	80	20	78	65	18	69	13	.....	.....	.....	2.93	+0.4	16	10,078	e.	35	e.	12	7	16	5	5.1	0.0	0.0
Panama Canal.																																
Balboa Heights	118	7	97	29.77	29.89	+.02	79.8	−0.5	90	10	88	68	17	72	20	71	69	80	T.	−0.8	0	8,143	nw.	30	nw.	20	8	20	0	4.1	0.0	0.0
Colon	36	7	97	29.88	29.92	+.02	80.5	+0.5	86	5	85	73	13	76	11	73	71	79	0.69	−0.9	10	12,295	n.	31	ne.	12	8	19	1	4.6	0.0	0.0
Alaska.																																
Juneau	80	11	54	.....	.....	.....	32.4	.....	45	27	37	9	14	28	19	29	24	75	13.39	.....	18	7,100	e.	94	e.	15	5	5	18	7.6	28.2	1.0

TABLE II.—*Data furnished by the Canadian Meteorological Service, February, 1923.*

Stations.	Altitude above mean sea level, Jan. 1, 1919.	Pressure.			Temperature of the air.						Precipitation.		
		Station reduced to mean of 24 hours.	Sea level reduced to mean of 24 hours.	Departure from normal.	Mean max.+mean min.÷2.	Departure from normal.	Mean maximum.	Mean minimum.	Highest.	Lowest.	Total.	Departure from normal.	Total snowfall.
	Feet.	*In.*	*In.*	*In.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	° *F.*	*In.*	*In.*	*In.*
St. Johns, N. F	125												
Sydney, C. B. I	48	29.87	29.92	.00	7.7	−11.6	15.8	−0.4	36	−16	1.15	−2.94	11.5
Halifax, N. S	88	29.86	29.98	+.03	13.6	−8.8	22.6	4.7	40	−5	1.91	−3.25	19.1
Yarmouth, N. S	65	29.92	30.00	+.01	19.5	−6.3	25.8	13.2	37	1	2.12	−2.62	21.2
Charlottetown, P. E. I	38	29.89	29.93	−.02	8.3	−9.3	15.8	0.7	35	−10	0.40	−2.66	4.0
Chatham, N. B	28	29.86	29.90	−.06	4.3	−8.2	16.8	−8.2	31	−27	0.36	−2.80	3.6
Father Point, Que	20												
Quebec, Que	296	29.72	30.06	+.07	5.7	−6.1	13.4	−2.1	33	−28	2.61	−0.66	26.1
Montreal, Que	187	29.84	30.07	+.05	9.1	−5.4	16.5	1.7	37	−22	2.36	−0.71	23.6
Stonecliffe, Ont	489												
Ottawa, Ont	236	29.82	30.11	+.09	7.6	−4.1	19.0	−3.7	36	−30	2.42	−0.27	24.2
Kingston, Ont	285	29.78	30.12	+.08	14.3	−3.5	22.4	6.2	37	−13	0.83	−1.71	8.2
Toronto, Ont	379	29.69	30.12	+.08	18.8	−2.7	26.6	11.0	43	−5	1.06	−1.55	10.5
Cochrane, Ont	930												
White River, Ont	1,244	28.66	30.06	+.04	−3.5	−3.7	13.3	−20.2	32	−50	1.01	−0.51	10.1
Port Stanley, Ont	592	29.49	30.16	+.10	18.7	−4.1	27.1	10.4	40	−10	1.29	−1.92	8.1
Southampton, Ont	656				14.7	−5.2	22.2	7.2	38	−10	2.49	−0.41	23.9
Parry Sound, Ont	688	29.35	30.10	+.09	9.0	−5.3	18.6	−0.7	35	−27	1.97	−0.95	19.7
Port Arthur, Ont	644	29.37	30.14	+.09	4.2	−2.2	13.2	−4.8	34	−30	0.29	−0.61	2.9
Winnipeg, Man	760	29.30	30.20	+.10	0.6	+2.2	10.3	−9.1	38	−33	1.03	+0.05	10.3
Minnedosa, Man	1,690	28.24	30.19	+.10	−1.8	+0.9	8.8	−12.4	34	−37	0.80	+0.19	8.0
Le Pas, Man	860				−2.0		10.4	−14.3	40	−40	0.40		4.0
Qu'Appelle, Sask	2,115	27.80	30.20	+.12	1.7	+2.3	12.8	−9.3	44	−36	0.80	+0.07	7.8
Medicine Hat, Alb	2,144												
Moose Jaw, Sask	1,759				3.6		13.9	−6.6	45	−31	0.61		6.1
Swift Current, Sask	2,392	27.55	30.35	+.28	5.0	−3.0	15.6	−5.5	48	−36	0.40	−0.34	3.6
Calgary, Alb	3,428												
Banff, Alb	4,521												
Edmonton, Alb	2,150												
Prince Albert, Sask	1,450	28.58	30.25	+.16	2.4	+5.4	15.2	−10.4	47	−41	0.07	−0.62	0.7
Battleford, Sask	1,592	28.39	30.26	+.17	3.8	+3.7	15.0	−7.4	52	−41	0.10	−0.27	1.0
Kamloops, B. C	1,262												
Victoria, B. C	230	30.01	30.27	+.27	37.6	−1.9	42.3	32.9	51	11	4.10	0.00	28.8
Parkerville, B. C	4,180												
Triangle Island, B. C	680												
Prince Rupert, B. C	170												
Hamilton, Ber	151	30.00	30.17	+.06	61.3	−0.2	67.4	55.2	73	44	3.23	−1.21	0.0

LATE REPORT, JANUARY, 1923.

St. Johns, N. F	125	29.62	29.76	−.10	23.9	+0.1	30.7	17.2	42	0	6.08	+0.17	28.0
Father Point, Que	20	30.03	30.06	+.08	4.5	−3.5	14.0	−5.0	39	−26	1.29	−0.56	12.5
Port Stanley, Ont	592	29.41	30.08	+.01	24.7	+2.5	31.5	17.9	40	2	3.32	+0.33	29.8
Calgary, Alb	3,428	26.21	29.92	−.11	16.8	+8.4	30.5	3.2	51	−25	0.30	−0.23	3.0
Banff, Alb	4,521	25.16	29.92	−.08	15.8	+5.7	24.3	7.3	36	−21	0.80	−0.39	8.0
Edmonton, Alb	2,150	27.50	29.90	−.13	6.5	+4.7	14.6	−1.5	33	−23	1.05	+0.37	10.5
Kamloops, B. C	1,262	28.69	30.02	+.06	26.0	+3.0	31.1	21.0	45	−5	0.30	−0.52	3.0
Barkerville, B. C	4,180	25.42	29.85	−.04	14.1	−3.7	21.2	7.2	35	−20	2.95	+0.35	29.5

CORRECTION.

TABLE II.—In this table for January, 1923, the lowest temperature recorded "35" *should be* "−35".

SEISMOLOGICAL REPORTS FOR FEBRUARY, 1923.

W. J. HUMPHREYS, Professor in Charge.

[Weather Bureau, Washington, April 3, 1923.]

TABLE 1.—*Noninstrumental earthquake reports, February, 1923.*

Day.	Approximate time, Greenwich civil.	Station.	Approximate latitude.	Approximate longitude.	Intensity Rossi-Forel.	Number of shocks.	Duration.	Sounds.	Remarks.	Observer.
1923.	*H. m.*	CALIFORNIA.	° ′	° ′			*Sec.*			
8	10 ..	Upper Mattole	40 15	124 15		1				W. W. Roscoe.
	11 30	....do	40 15	124 15		1				Do.
	12 ..	....do	40 15	124 15		1				Do.
9	11 15	Eureka	40 48	124 10	2	1	2	None	Felt by several	L. B. Cooper.
		MONTANA.								
20	23 32	Helena	46 40	112 00	4	2	3,1	....do	Felt by many	U. S. Weather Bureau.
		WASHINGTON.								
12	18 15	Marietta	48 50	122 40		1	10	Rattling	....do	S. B. Mayhew.

TABLE 2.—*Instrumental seismological reports, February, 1923.*

[Time used: Mean Greenwich, midnight to midnight. Nomenclature: International.]

(For significance of symbols and description of stations, see the REVIEW for January, 1922.)

CALIFORNIA. *Theosophical University, Point Loma.*

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1923			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Feb. 9					150	150		Tremors during preceding 24 hours.
18					200	200		
27					50	50		
28					50	100		

COLORADO. *Regis College, Denver.*

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1923			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Feb. 3		P	16 10 ..		*10,000	* 4,000		Heavy machinery in motion near by.
		S_N	16 18 ..			*10,000		
		S_E	16 17 30		*14,000			
		L_N	16 27 ..	40-60		*7,000		
		L_E	16 26 ..	40-60	*10,000			
		M_N	16 36 ..	28		*18,000		
		M_E	16 34 ..	29	*24,000			
		C_N	17 20 ..	13				
		C_E	17 25 ..	15				
		F_N	19					
		F_E	18 50 ..					
24		P_E	9 56 ..					Time somewhat doubtful.
		L_E	10 14 ..		*3,000			
		M_E	10 19 ..	15-20				
		F_E	10 28 ..					
26								Visible activity on NS, 8-10.

*Trace amplitude.

DISTRICT OF COLUMBIA. *U. S. Weather Bureau, Washington.*

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1923			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Feb. 2		P	1 18 20					
		L	1 44 ..	22				
		L	1 52 ..	16				
		F	2 10 *ca.*					
2		P	5 19 19				8,200	
		S	5 28 51					
		eL	5 44 ..					
		L	5 47 ..	20				
		F	7 45 ..					
3		P	16 13 24					
		S	16 23 ..					
		L	16 34 ..	40				
		M	16 49 ..		*24,000			
		L	16 42 ..	20				
		F	20 30 *ca.*					
3		P	17 52 36					Feeble.
		S	18 02 06					
3		P	18 54 36					Very small.
		S	19 02 16					
8		P	0 39 28				3,100	Rapid vibration.
		S	0 44 06					
		F	1 10 *ca.*					
11		e	23 25 ..					
		L	23 30 ..	16				
		F	23 45 ..					
12		P	2 10 23				8,000	
		S	2 19 43					
		L	2 19 38	22				
		F	3 00 00					
23		P	6 14 37				4,300	
		S	6 20 42					
		F	14 35 ..					
24		P	7 46 00				3,600	
		S	7 51 20					
		eL	7 55 00	20				
		L	8 04 ..	20				
		F	10 20 ..					
27		e	20 42 00					L indistinguishable.
		S	20 46 28					
		F	21 10 *ca.*					

* Trace amplitude.

ILLINOIS. *U. S. Weather Bureau, Chicago.*

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1923			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Feb. 1		P?	19 45 00					
		S?	19 54 ..					
		L	20 18 ..	35				
		L	20 22 ..	22				
		F	21 40 *ca.*					
2		P	1 17 20				7,600	
		S	1 26 20					
		eL?	1 38 40					
		L	1 42 ..	22				
		F	2 50 *ca.*					
2		P	5 18 32				7,600	Irregular record.
		S	5 27 29					
		L	5 41 00					Not well defined.
		F	9 20 *ca.*					
3		P	16 12 33				7,800	
		S	16 21 43					L indistinguishable.
		M	16 50 ..		*50,000			
4		F	4 *ca.*					
8		P	0 38 54				2,900	
		S	0 43 32					
		L	0 46 30					
		F	1 50 *ca.*					
8		e	8 11 30					
		L	8 27 ..	15				
		F	9 30 *ca.*					
9		e	11 28 26					
		F	11 40 *ca.*					
11		P	22 56 27				7,400	
		S	23 05 17					
		L	23 18 40	20				
12		F	0 40 ..					
12		P	2 09 40					
		S	2 18 24					
		L	2 34 ..	18				
		F	4 30 *ca.*					
19		e	0 04 ..					
		L	0 15 ..	20				
		F	1 *ca.*					Micros.
21		P	1 05 04				8,300	
		S	1 14 40					
		L	1 30 ..	20				
		F	2 15 ..					
21		P	4 00 48					
		S	4 10 04					
		L	4 25 06	20				
		F	5 *ca.*					
23		P	6 13 57					
		S	6 19 40					L indistinguishable.
		F	8 *ca.*					
24		P	7 45 06				7,500	
		S	7 54 00					
		L	8 07 20					
		M	8 12 ..		*20,000			
		F						Lost in micros.
27		P	20 42 14				2,800	
		S	20 46 40					L indeterminate.
		F	21 40 *ca.*					
28		eL	22 39 ..					
		F	23 *ca.*					

* Trace amplitude.

NEW YORK. *Fordham University, New York.*

Date.	Character.	Phase.	Time.	Period T.	Amplitude. A_E	Amplitude. A_N	Distance.	Remarks.
1923			*H. m. s.*	*Sec.*	μ	μ	*Km.*	
Feb. 2		L_E	1 46 ..					Preliminaries not discernible.
2		O	5 07 43				8,200	Clock correction uncertain.
		P_N	5 19 17					
		S_E	5 28 46					
		S_N	5 28 49					
		L	5 45 ..					
		M_E	5 50 54		*875			

NEW YORK.—*Fordham Univertity, New York*—Continued.

1923 Feb. 3		O	16 03 06				8,000	
		P_E	16 14 25					
		P_N	16 14 27					
		S_N	16 23 44					
		S_E	16 23 45					
		$L?_E$	16 35 ..					
		$L?_N$	16 35 ..					
		L_N	16 40 ..					
		M_E	16 44 ..		*13,750			
3		L_E	19 22 ..					
		L_E	19 30 ..					
		M_E	19 33 ..					
12		e_E	2 31 31					Obscured by micros.
		L_E	2 39 ..					
24		O	7 34 28				8,380	First preliminaries doubtful, obscured by micros.
		eP_N	7 46 17					
		eP_E	7 46 09					
		eS_E	7 55 48					
		L_E	8 10 ..					
		M_E	8 17 25		*1,500			
27		e_E	20 51 32					Obscured by micros.
		L_E	20 55 ..					

* Trace amplitude.

CANAL ZONE. *Panama Canal, Balboa Heights.*

1923			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
					25 KILOGRAM.			
Feb. 3		S_N	16 27 08				11,200*ca*	Probably northwest.
		L_N	16 34 56					
		L_E	16 35 00					
		M_N	17 03 00			*1,500		
		M_E	17 01 25		*3,000			
		F_N	18 30 00					
		F_E	18 40 00					
					100 KILOGRAM.			
		P_E	16 15 04					
		P_N	16 15 16					
		S	16 27 12					
		L_E	16 34 44					
		L_N	16 35 03					
		M_E	17 01 29		*3,500			
		M_N	17 02 48			*4,000		
		F_E	18 40 00					
		F_N	18 44 00					
9		P_E	18 52 45				400*ca.*	Probably northwest. Remainder of records from 100 kg. instrument.
		P_N	18 52 48					
		S	18 53 32					
		M_E	18 53 34		*1,000			
		M_N	18 53 48			*1,800		
		F_E	18 58 00					
		F_N	18 58 00					
26		P	9 35 24					Slight disturbance; probably local.
		F	11 37 00					

* Trace amplitude.

VERMONT. *U. S. Weather Bureau, Northfield.*

1923			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*
Feb. 2		S?	5 28 20				
		L	5 49 ..	16			
		F	6 30 *ca.*				
3		P	16 13 08				8,200
		S	16 22 30				
		L?	16 35 ..	40			
		M	16 55 *ca.*		*70,000		
		F	20 *ca.*				
8		e	0 52 ..				
		L	0 58 ..	20			
		F	1 08 *ca.*				
12		e	2 40 ..				
		L	2 43 ..	20			
		F	2 55 ..				
24		P	7 45 24				
		S?	7 49 08				
		L	7 55 04	20			
		M_E	8 17 ..		*19,000		
		F	9 40 *ca.*				

* Trace amplitude.

Reports for February, 1923, have not been received from the following stations:

ALABAMA. *Spring Hill College*, Mobile.
ALASKA. *U. S. C. & G. S. Magnetic Observatory*, Sitka.
ARIZONA. *U. S. C. & G. S. Magnetic Observatory*, Tucson.
DISTRICT OF COLUMBIA. *Georgetown University*, Washington.
HAWAII. *U. S. C. & G. S. Magnetic Observatory*, Honolulu.
MARYLAND. *U. S. C. & G. S. Magnetic Observatory*, Cheltenham.
MASSACHUSETTS. *Harvard University*, Cambridge.
MISSOURI. *St. Louis University*, St. Louis.
NEW YORK. *Cornell University*, Ithaca.
PORTO RICO. *U. S. C. & G. S. Magnetic Observatory*, Vieques.
CANADA. *Dominion Observatory*, Ottawa; *Dominion Meteorologica Service*, Toronto *and* Victoria.

TABLE 3.—*Late reports (instrumental).*

CANAL ZONE. *Panama Canal, Balboa Heights.*

1923			*H. m. s.*	*Sec.*	*μ*	*μ*	*Km.*	
Jan. 22								Slight tremors from distant disturbance, probably to the north between 9:05 and 10:20.

○

Chart I. Tracks of Centers of Anticyclones, February, 1923. (Inset) Departure of Monthly Mean Pressure from Normal.
(Plotted by Wilfred P. Day.)

Chart I. Tracks of Centers of Anticyclones, February, 1923. (Inset) Departure of Monthly Mean Pressure from Normal.
(Plotted by Wilfred P. Day.)

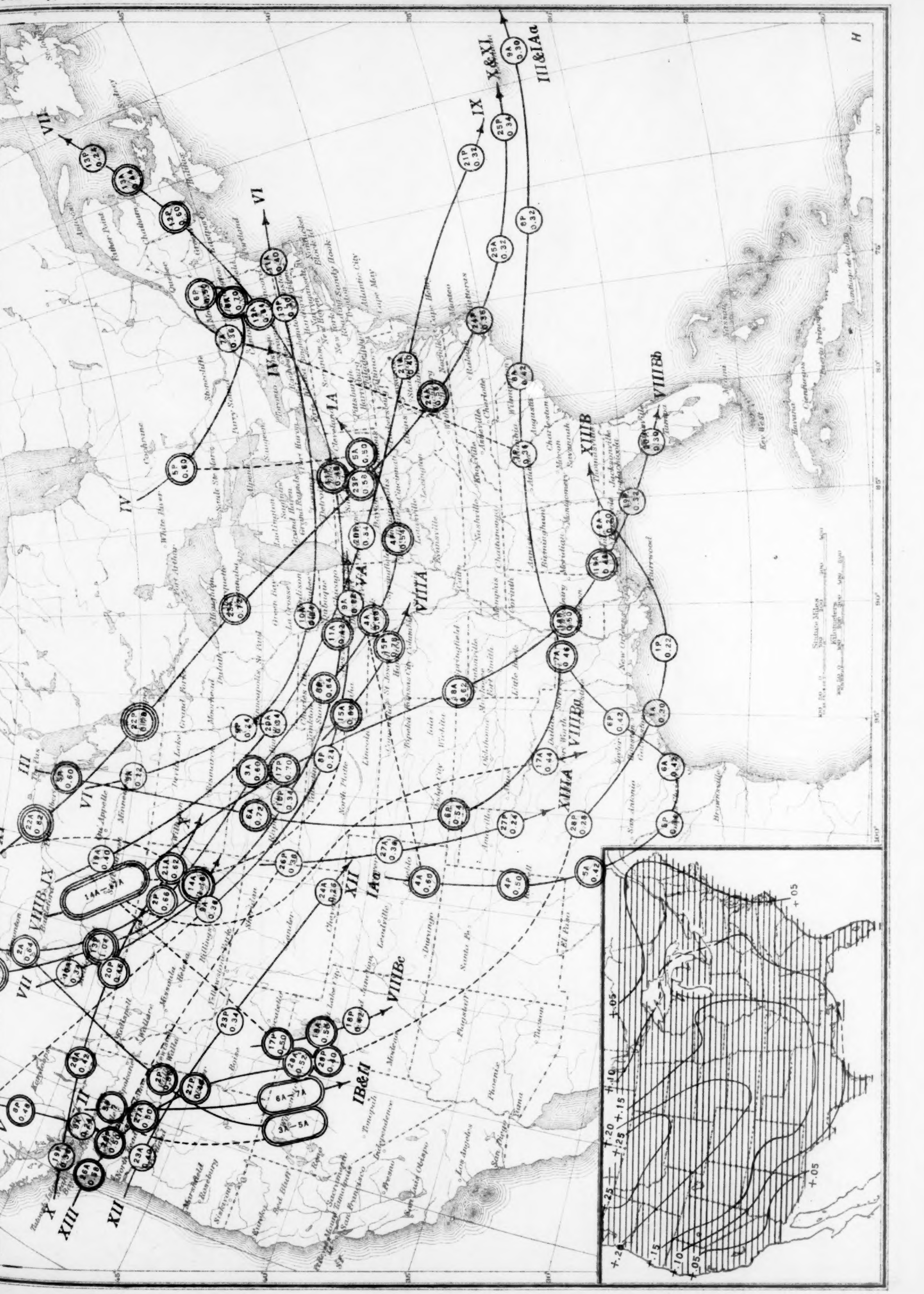


Chart II. Tracks of Centers of Cyclones, February, 1923. (Inset) Change in Mean Pressure from Preceding Month.
(Plotted by Wilfred P. Day.)

Chart III. Departure (°F.) of the Mean Temperature from the Normal, February, 1923.

Chart III. Departure (°F.) of the Mean Temperature from the Normal, February, 1923.

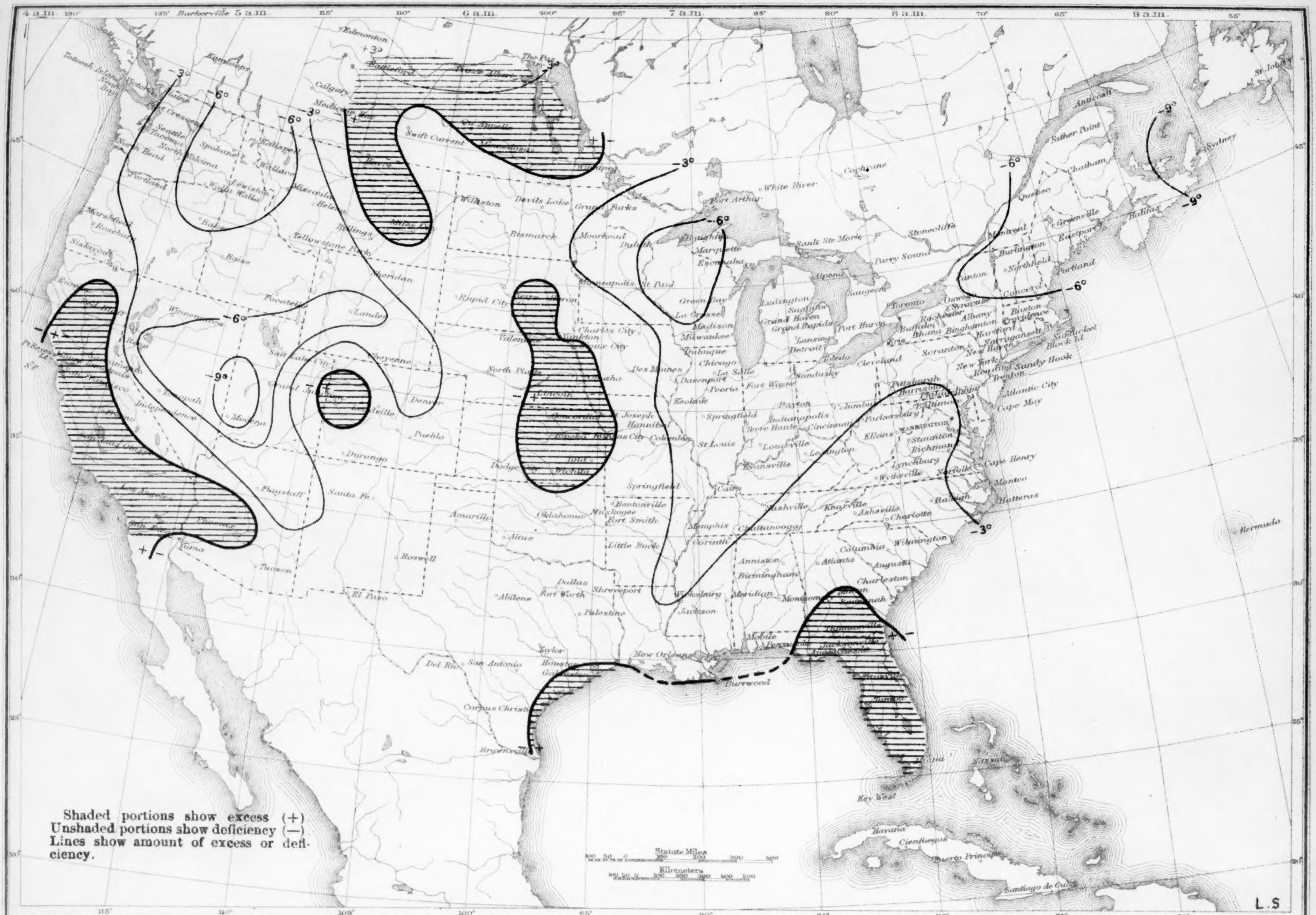


Chart IV. Total Precipitation, Inches, February, 1923. (Inset) Departure of Precipitation from Normal.

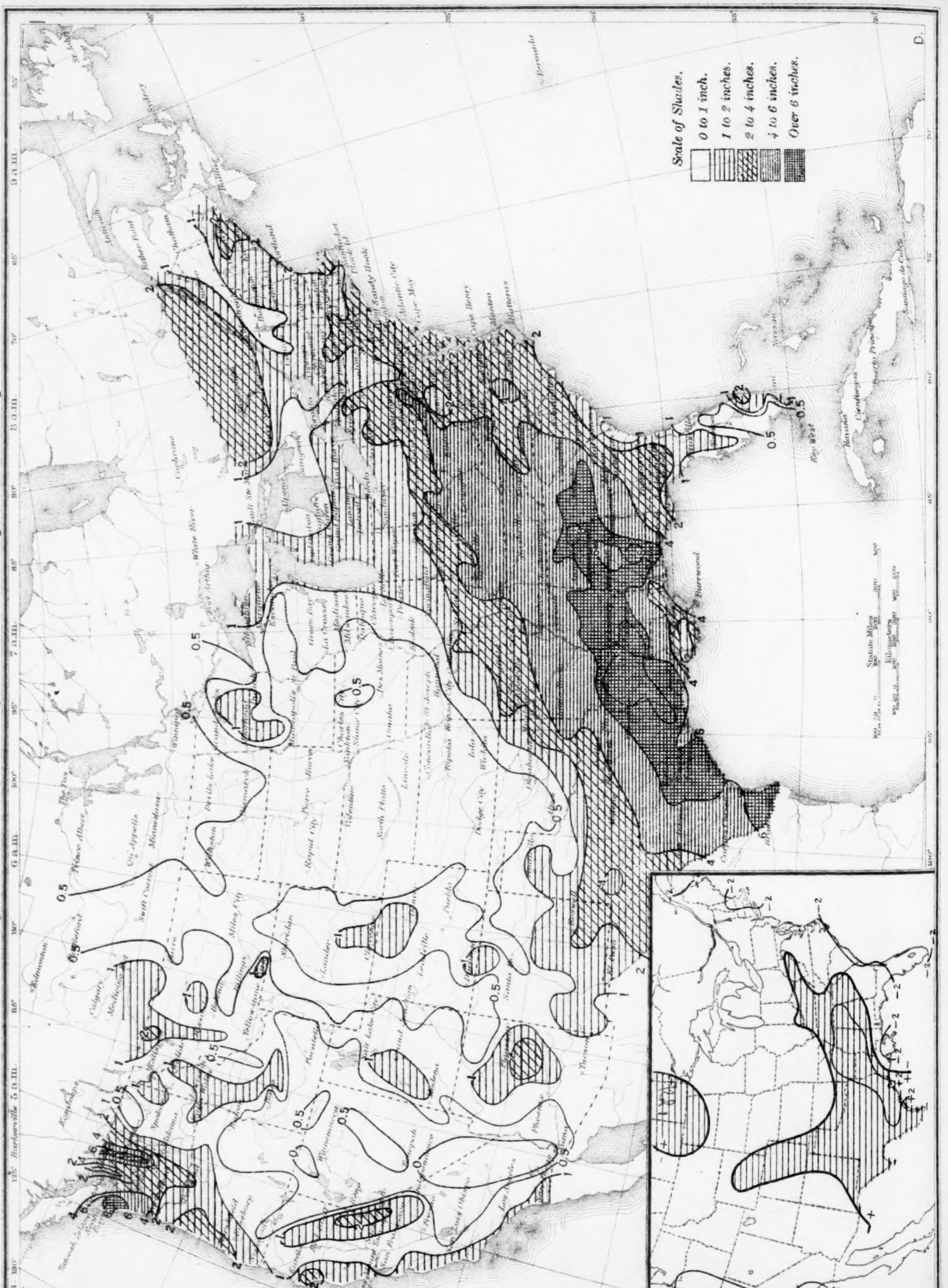


Chart V. Percentage of Clear Sky between Sunrise and Sunset, February, 1923.

Chart V. Percentage of Clear Sky between Sunrise and Sunset, February, 1923.

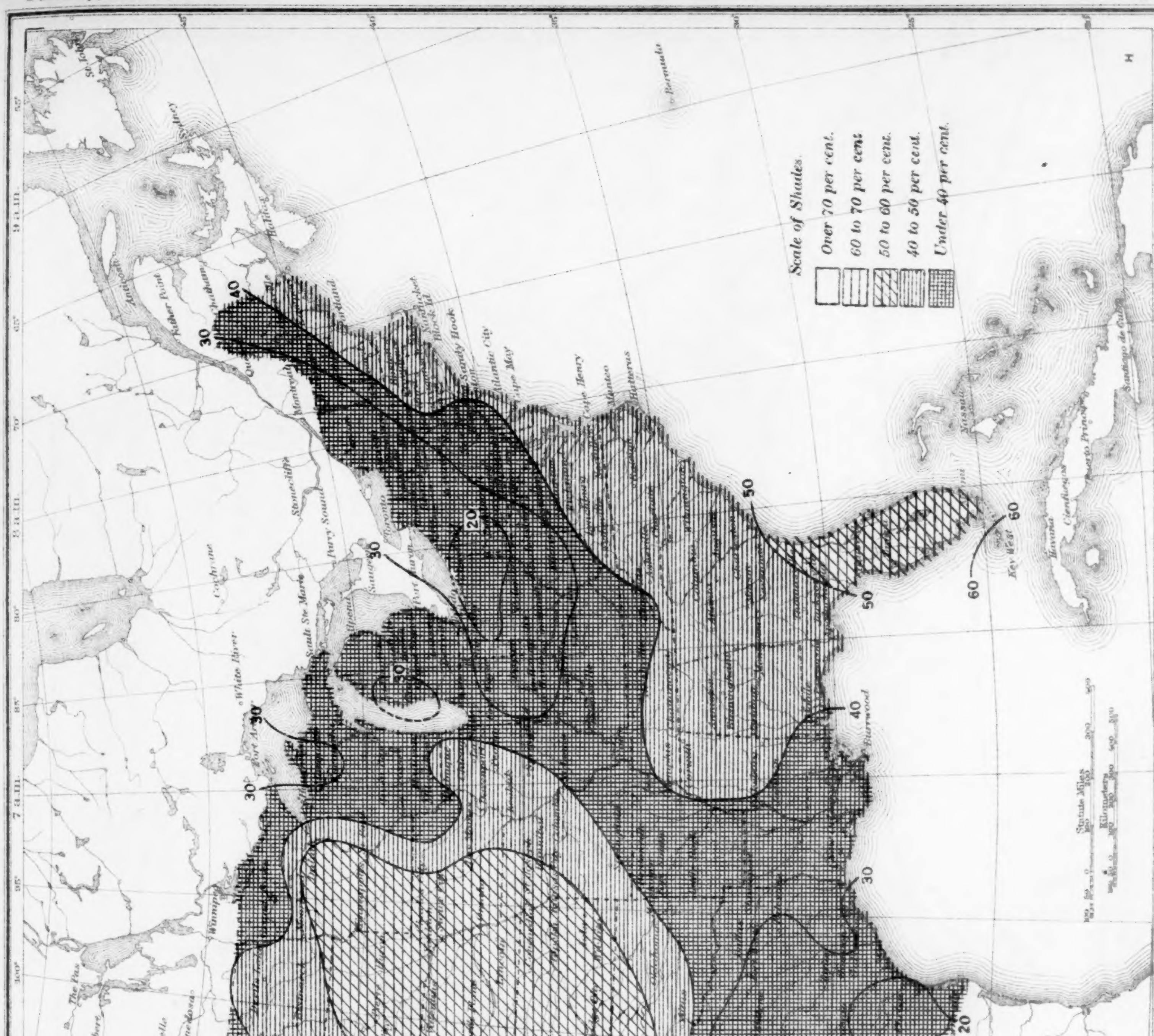


Chart VI. Isobars at Sea-level and Isotherms at Surface; Prevailing Winds, February, 1923.

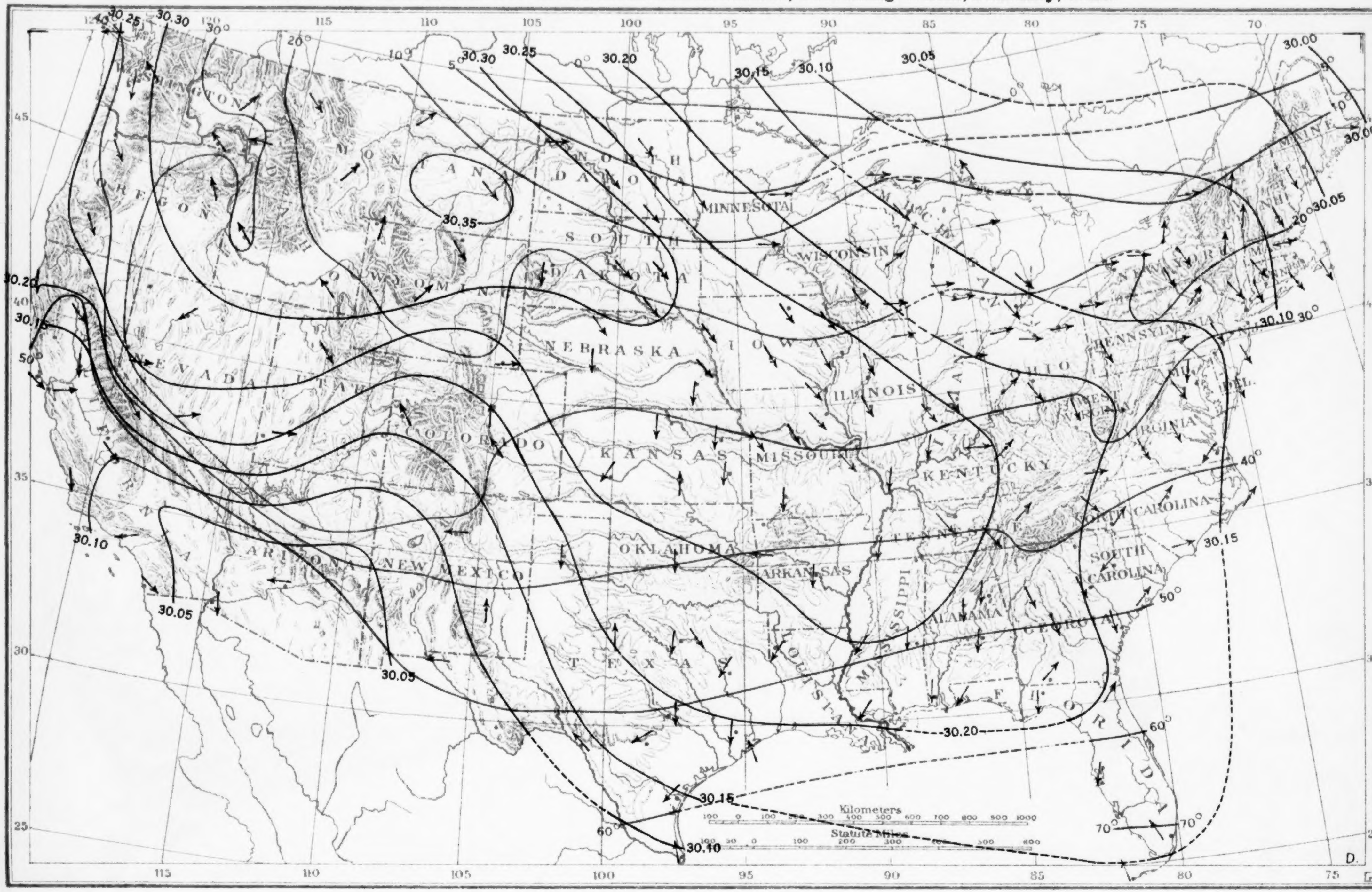


Chart VII. Total Snowfall, Inches, February, 1923. (Inset) Depth of Snow on Ground at end of Month.

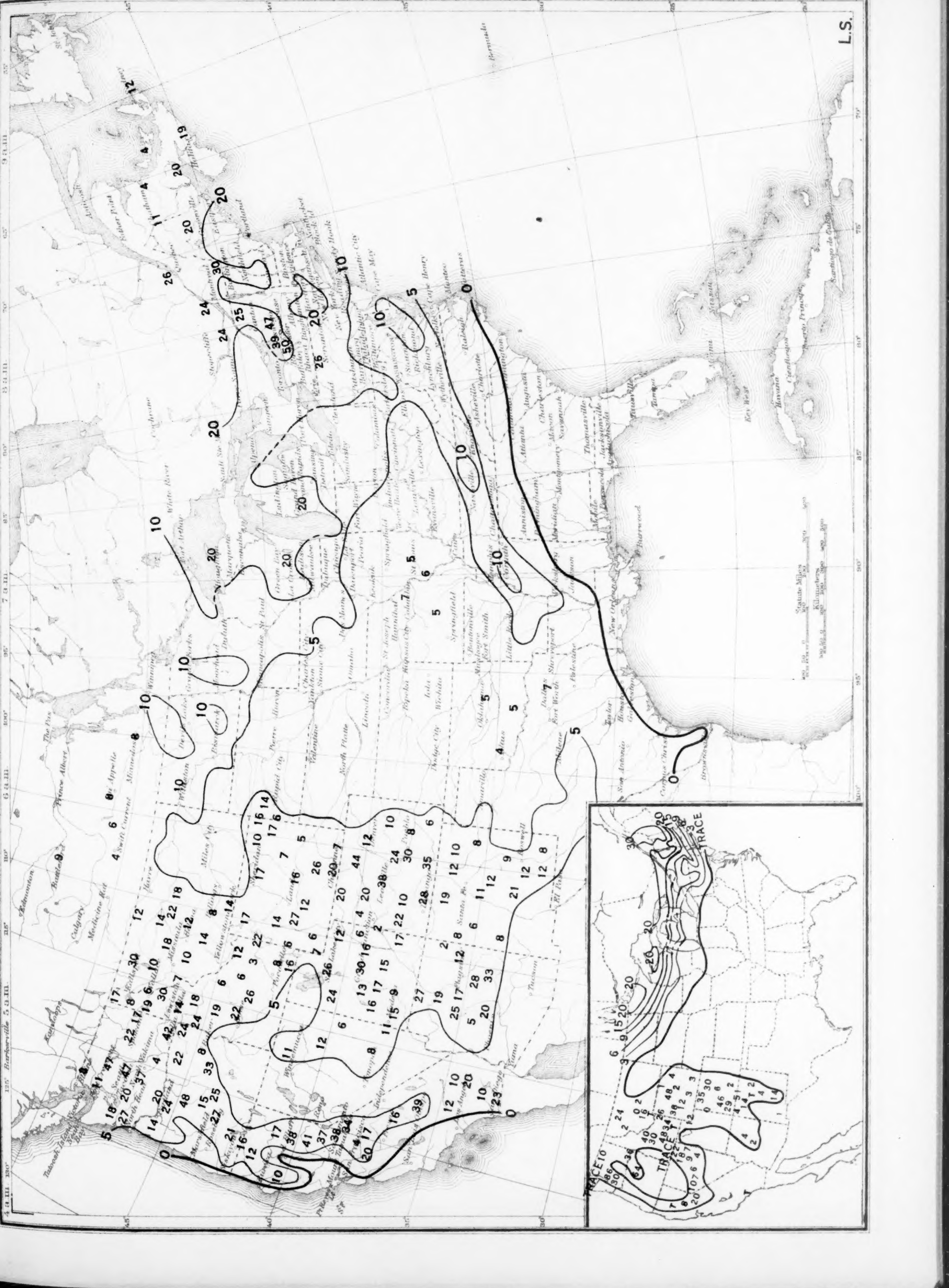


Chart VIII. Weather Map of North Atlantic Ocean, February 5, 1923.
(Plotted by F. A. Young.)

Chart VIII. Weather Map of North Atlantic Ocean, February 5, 1923.
(Plotted by F. A. Young.)

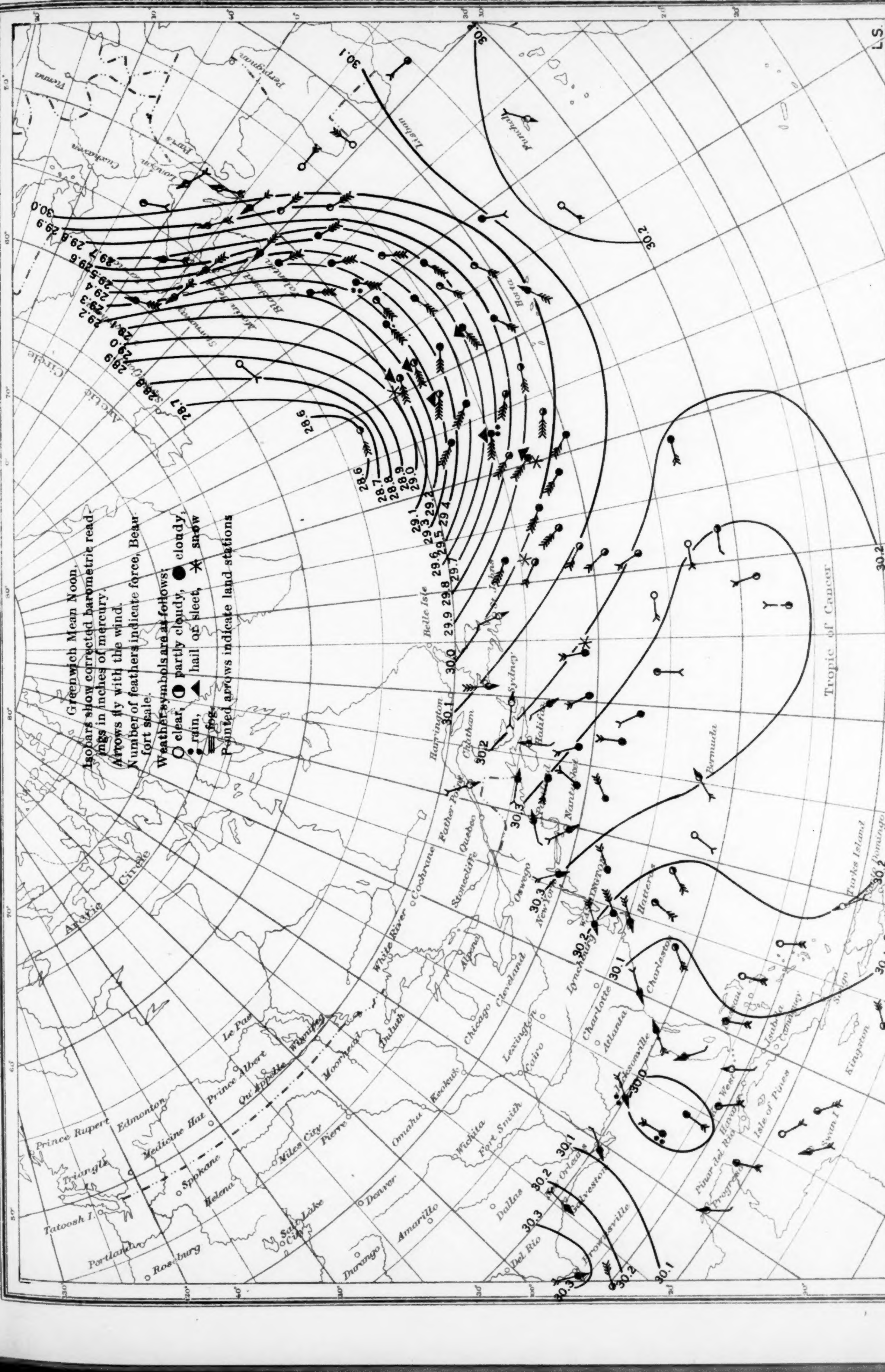
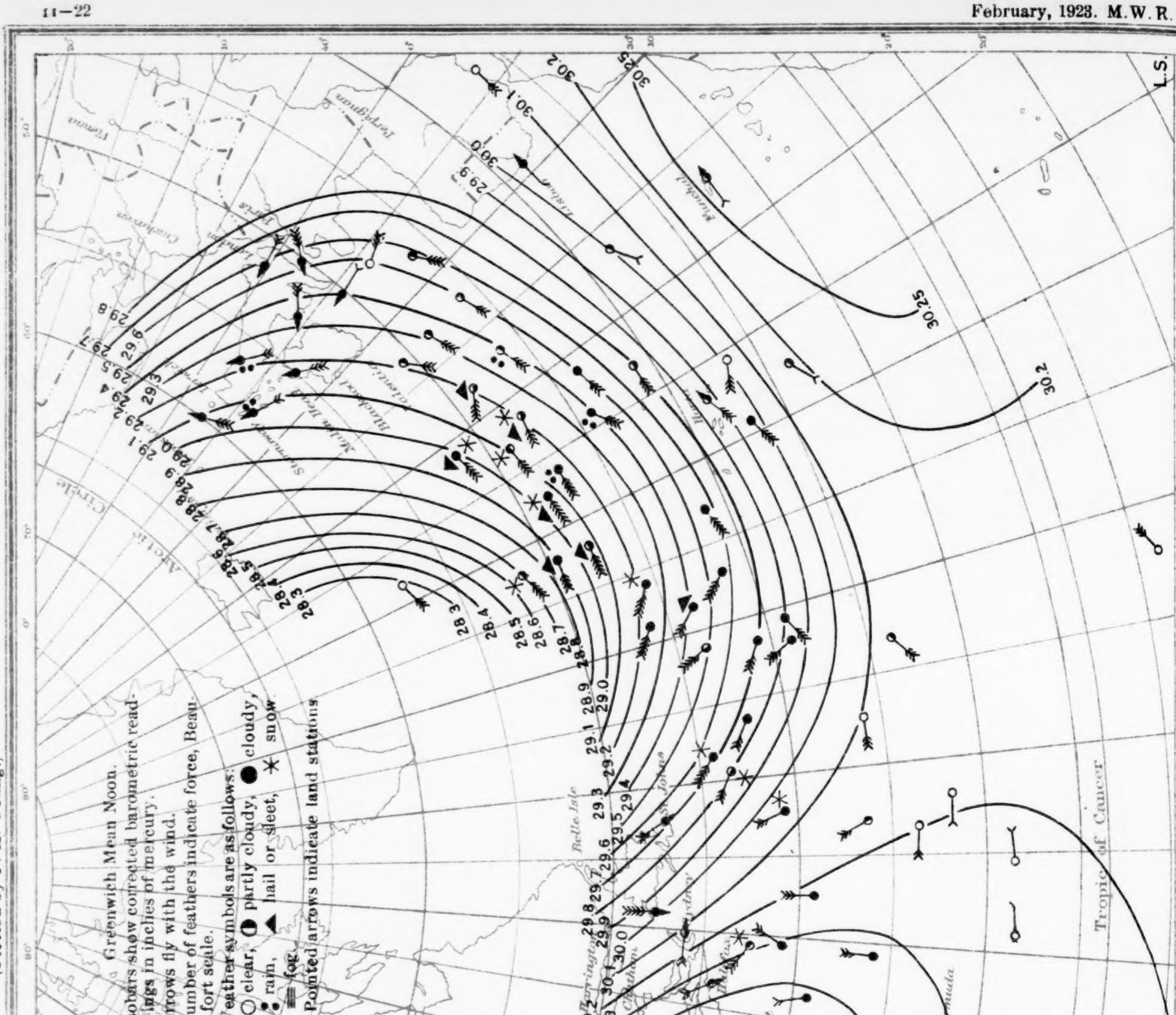


Chart IX. Weather Map of North Atlantic Ocean, February 6, 1923.
(Plotted by F. A. Young.)



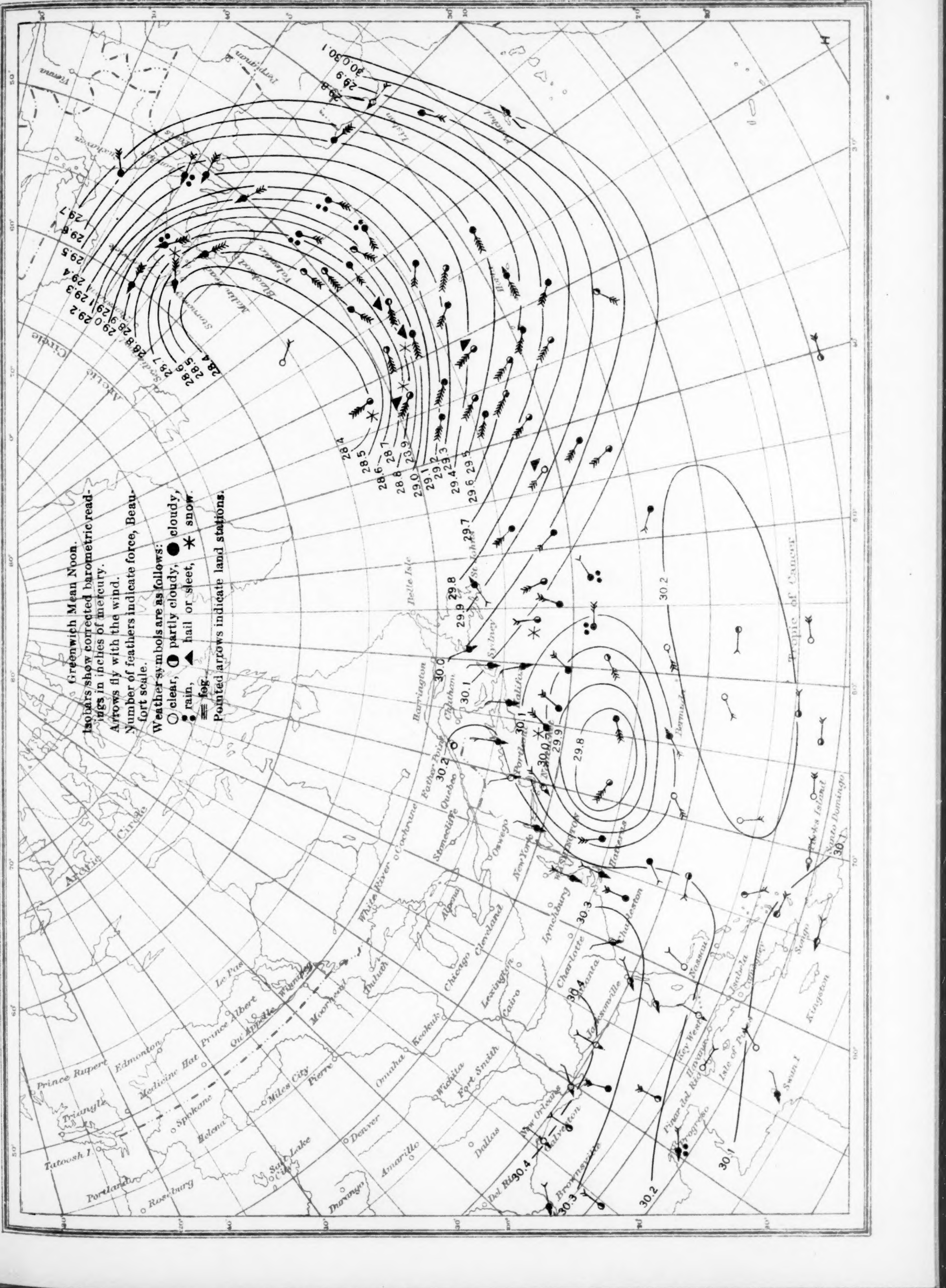


Chart X. Weather Map of North Atlantic Ocean, February 7, 1923.
(Plotted by F. A. Young.)

Chart XI. Weather Map of North Atlantic Ocean, February 8, 1923.

(Plotted by F. A. Young.)

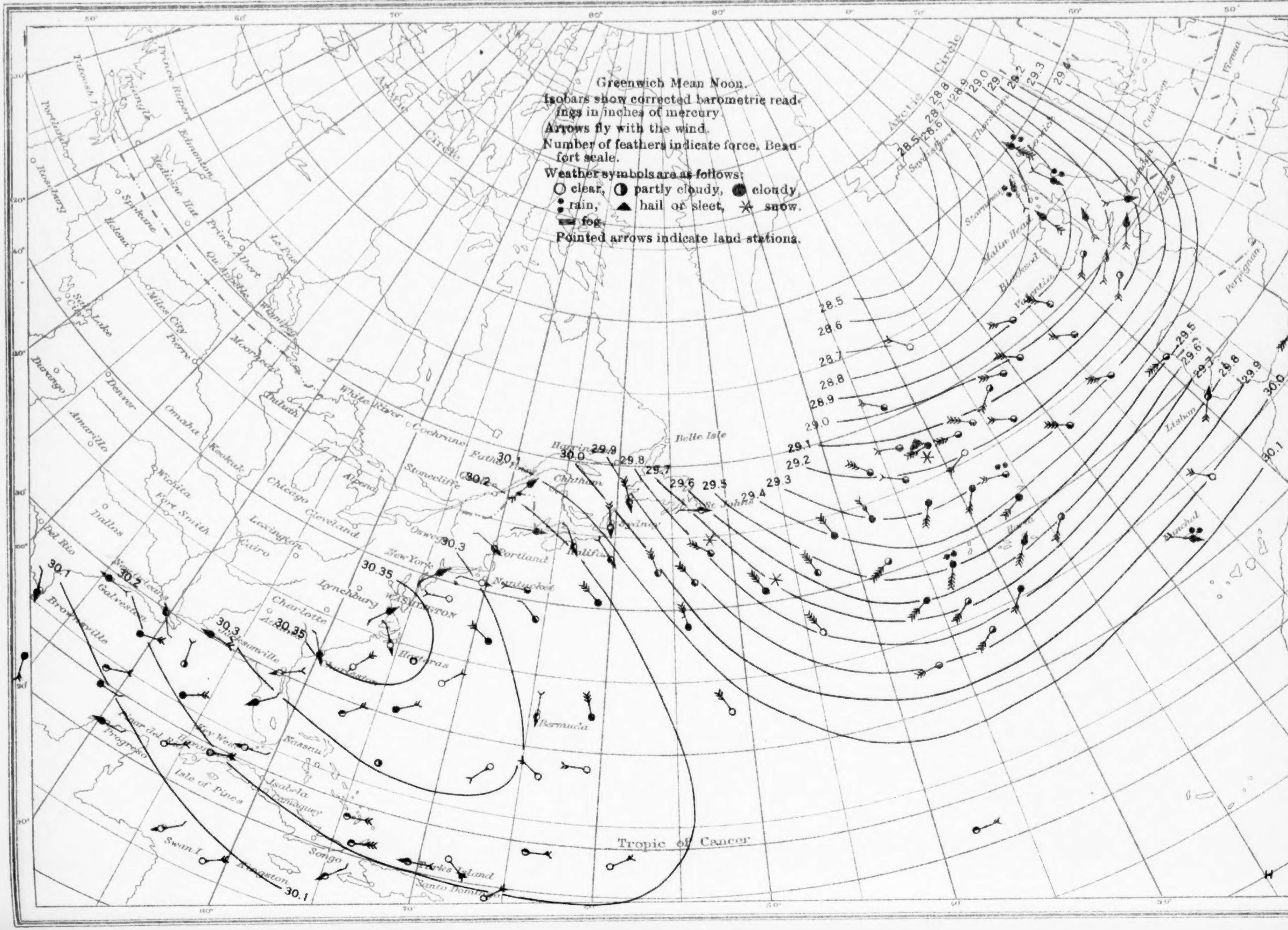


Chart XII. Weather Map of North Atlantic Ocean, February 9, 1923.

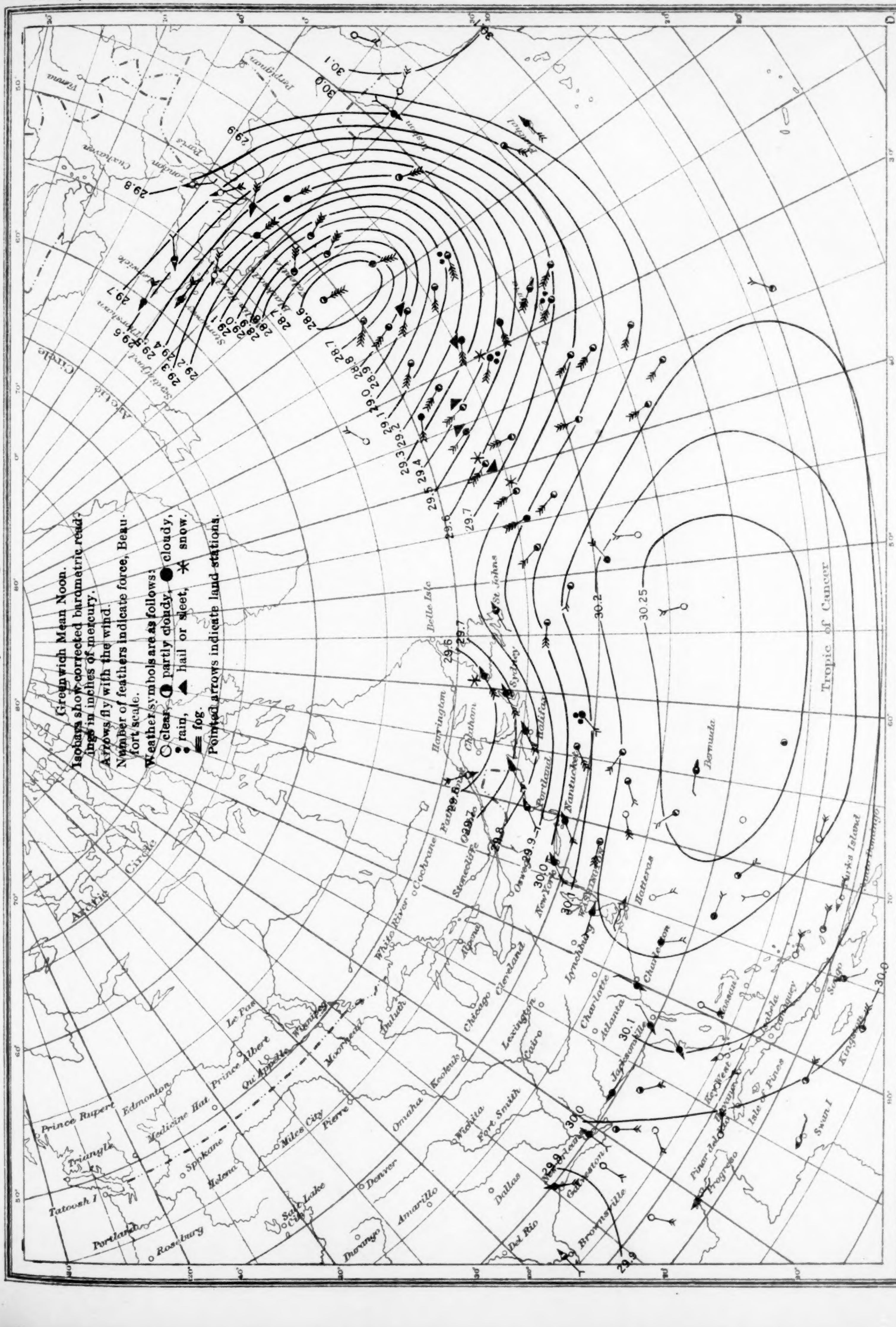


Chart XII. Weather Map of North Atlantic Ocean, February 9, 1923.
(Plotted by F. A. Young.)

Chart XIII. Weather Map of North Atlantic Ocean, February 10, 1923.
(Plotted by F. A. Young.)